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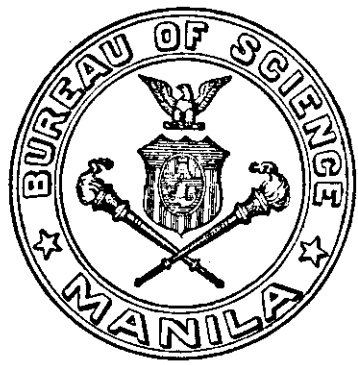

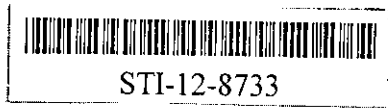
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THE PHILIPPINE
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VOL. 41 JANUARY, 1930 No. 1

NEW BETHYLID AND SERPHOID PARASITES FROM BORNEO AND THE PHILIPPINE ISLANDS

By ROBERT FOUTS

Of Hollywood, California

FOUR TEXT FIGURES

This paper is based on material submitted for determination by the late Prof. C. F. Baker and contains descriptions of twelve new species belonging to the families Bethylidæ, Scelionidæ, and Diapriidæ. The types of the new species are deposited in the collection of the United States National Museum. The manuscript was completed prior to the transfer of the Baker collection to the National Museum, and in order that there be no confusion of the specimens before the author no change in the records on the location of types has been made in the text.

BETHYLIDÆ

Genus MESITIUS Spinola

Key to Oriental species of Mesitius Spinola.

1. Pronotum with a distinct median longitudinal furrow; each lateral area of mesonotum traversed by a longitudinal groove..... 2.
   Pronotum at the most with a trace of a median furrow; lateral areas of the mesonotum without groove..... *M. indicus* Kieffer.
2. Terminal three abdominal segments red.... *M. haemorrhoidalis* Magretti.
   Abdomen black (last segment dull red in *bakeri*)..... 3.
3. Second tergite strongly punctate..... 4.
   Second tergite finely punctate..... 5.
4. Antennal joints 4 to 13 twice as long as wide..... *M. luzonicus* Kieffer.
   Antennal joints 4 to 13 more than twice as long as wide.
   M. philippinensis Kieffer.

5. Lateral anterior angles of the pronotum projecting slightly, acute. *M. punctaticollis* sp. nov.
Anterior angles of pronotum not projecting ..... 6.
6. Legs dark brown ..... *M. orientalis* sp. nov.
Legs mostly rufous ..... *M. bakeri* sp. nov.

MESITIUS PUNCTATICOLLIS sp. nov.

Male.—Length 3.0 millimeters. Head 1.1 times as wide as long, shagreened, very closely covered with large shallow circular punctures; scape about as long as the third joint; second joint a little over half as long as the third, less than twice as long as wide; thorax 1.15 times as wide as the head, 1.44 times as long as wide; pronotum very roughly sculptured, with many large deep pits which are several times larger than those on the head; lateral anterior margins of the pronotum acute, projecting; the pronotum anteriorly elevated on each side of the median line leaving a poorly defined median furrow; mesonotum on each side with a well-defined longitudinal groove; propodeum seen from above with five longitudinal ridges (not counting the lateral edge of the sclerite), the area between these ridges traversed by many fine carinæ; lateral angles of the propodeum fairly sharp but not especially prominent, not extending beyond the segment; abdomen slightly longer than the thorax, 0.8 as wide as the head, nearly twice as long as wide; first tergite polished, with small scattered punctures on anterior two-thirds; second tergite polished, also with numerous small scattered punctures on anterior two-thirds; following tergites without sculpture; wings normally developed, brownish, paler medially; black; mandibles, antennæ, and legs brownish.

Type locality.—Borneo, Sandakan (*Baker*), one male.

Type.—Catalogue No. 29203, United States National Museum.

MESITIUS ORIENTALIS sp. nov.

Male.—Length 3.30 millimeters. Pronotum with a moderately broad median groove; lateral grooves on pronotum distinct only on posterior half of the sclerite; wings normally developed, subhyaline, paler medially, reaching beyond the middle of the second tergite; head shagreened, closely covered with large shallow pits; pronotum as long as wide across the middle, smoother than the head, with the pits as large as on the head but fewer, more scattered, and with their margins less sharply indicated; propodeum as in *punctaticollis* but the lateral angles sharper, projecting as far as the apices of the hind coxæ; first tergite with only a few scattered punctures medially; second tergite

with many small scattered punctures on basal three-fourths; third tergite with a few punctures at extreme base; wings fully developed; black; mandibles reddish yellow; antennæ brownish to piceous; legs dark brown, the anterior tibiæ apically, and all the tarsi, yellowish.

Type locality.—Mindanao, Bukidnon, Tangkulan (*Baker*), one male.

Type.—Catalogue No. 29202, United States National Museum.

MESITIUS BAKERI sp. nov.

Male.—Length 5.00 millimeters. Punctures on head very close, circular, deep; pronotum shaped as in *orientalis,* fairly smooth, with the punctures scattered and shallower than those on the head; lateral grooves on the mesonotum narrow, reaching nearly to the anterior margin; scutellum smooth, with a few small scattered punctures; propodeum as in *orientalis;* first tergite without punctures; second tergite closely punctulate on anterior three-fourths; third tergite punctulate on basal one-half; wings normally developed, yellowish; black; scape, mandibles, tegulæ, and legs rufous.

Type locality.—Luzon, Mount Maquiling (*Baker*), one male.

Type.—Catalogue No. 29201, United States National Museum.

Genus MISEPYRIS Kieffer

Key to Oriental species of Misepyris Kieffer.

1. Pronotum and mesonotum longitudinally striate.... *M. exaratus* Kieffer.
   Pronotum and mesonotum polished, punctate..... 2.
2. Part of head behind eyes about as long as the eyes..... 3.
   Part of head behind eyes distinctly shorter than the eyes..... 4.
3. Head with punctures closely set..... *M. longiceps* Kieffer.
   Head with punctures not close together and not well defined. *M. flavipes* sp. nov.
4. Transverse carina dividing the anterior and posterior faces of the propodeum straight, not interrupted medially..... 5.
   Transverse carina curving upward medially, angulate or interrupted medially by pits ..... *M. mindanaensis* sp. nov.
5. Anterior face of propodeum about as long as the mesonotum; posterior femora dark brown ..... *M. politus* sp. nov.
   Mesonotum two-thirds the length of the propodeum; posterior femora yellow ..... *M. luzonicus* sp. nov.

MISEPYRIS FLAVIPES sp. nov.

Male.—Length 4.5 millimeters. Head longer than wide, as wide as the thorax, polished; punctures on frons numerous but not very closely set, not as close together as in *luzonicus,* for instance; the edges of the punctures not well defined, part of

head behind the eyes about as long as the eyes; pronotum polished, with a few indistinct punctures laterally and anteriorly; notauli complete; propodeum as long as the mesonotum and pronotum united, with three longitudinal carinæ dorsally, one median and two oblique ones on either side; posterior face of propodeum shining, sparsely punctate, not rugose; madibles rufous; antennæ reddish yellow, the terminal four joints brown, legs yellow to reddish yellow, the posterior femora brown.

Type locality.—Luzon, Mount Maquiling (*Baker*), two males.

Type.—Catalogue No. 29197, United States National Museum; paratype in Baker collection.

MISEPYRIS MINDANAENSIS sp. nov.

Male.—Length 5.30 millimeters. Head seen from in front almost circular; punctures on frons numerous, small, many times their diameters distant from one another; pronotum smooth, with scattered small punctures; notauli present; anterior face of propodeum a little over half as long as the mesonotum and scutellum united, with a strong median longitudinal ridge, and with many interrupted transverse carinæ; posterior face shining, with a number of large shallow pits above and on the sides, finely transversely wrinkled medially; black, mandibles rufous; antennæ light brown, darker on apical half; legs yellow to light brown, the posterior femora darker.

Type locality.—Mindanao, Butuan (type) and Surigao (paratype) (*Baker*), two males.

Type.—Catalogue No. 29198, United States National Museum; paratype in Baker collection.

MISEPYRIS POLITUS sp. nov.

Male.—Length 3.80 millimeters. Head longer than wide, as wide as the thorax; punctures on frons widely scattered, very shallow, poorly defined; pronotum polished, with several poorly defined punctures anteriorly; notauli complete; anterior face of propodeum with only one longitudinal carina; lateral areas on anterior face finely wrinkled on apical half; posterior face reticulate, the areas large, well defined; mandibles rufous; antennæ brown, the scape and pedicel lighter; legs yellow, the posterior femora brown.

Type locality.—Mindanao, Surigao (*Baker*), one male.

Type.—Catalogue No. 29199, United States National Museum.

MISEPYRIS LUZONICUS sp. nov.

Male.—Length 5.5 millimeters. Head longer than wide, smooth, moderately closely covered with rather small punctures,

the punctures distinct, sharply indicated; pronotum only slightly longer than the mesonotum, with a small furrow basally, and with punctures similar to those on the head; anteriorly the pronotum is slightly transversely wrinkled, the punctures at this place indistinct, confluent; notauli complete, nearly parallel; mesonotum with a few scattered punctures; propodeum as long as the mesonotum and scutellum united, transversely wrinkled, with a delicately impressed median carina; posterior transverse carina delicate but distinct; posterior face of propodeum finely transversely wrinkled; abdominal tergites extremely delicately shagreened; black; mandibles, basal, four antennal joints, and legs yellowish; first and second tergites at extreme apices rufous.

Type locality.—Luzon, Mount Maquiling (*Baker*), two males.

Type.—Catalogue No. 29200, United States National Museum; paratype in Baker collection.

Genus PRISTOCERA Klug

PRISTOCERA PUNCTICEPS sp. nov.

Female.—Length 5.0 millimeters. Head one and one-fifth times as long as wide, thickly covered with large deep pits which are about their diameter distant from one another; narrow line down center of frons without punctures; pronotum with a row of large deep pits laterally and with a few above on the sides anteriorly; two pits posteriorly on the dorsal surface of the pronotum; pronotum otherwise polished, without sculpture; thorax a little less than twice as long as the head, slightly more than three times as long as wide; propodeum dorsally without sculpture, posteriorly shagreened, with a few large scattered punctures, the hairs issuing from these punctures erect; abdomen one and one-fifth times as long as the thorax, 1.7 times as wide as the thorax, one-fourth times as long as wide.

Head and thorax black; abdomen black, brownish toward the apex above; abdomen laterally and ventrally brownish; mandibles, antennæ, and legs reddish brown.

Type locality.—Mindanao, Dapitan (*Baker*), one female.

Type.—Catalogue No. 29205, United States National Museum.

SCELIONIDÆ

Genus SCELIO Latreille

SCELIO BICOLOR sp. nov. Fig. 1.

Male.—Length 5.50 millimeters. Runs to *macrotomus* Kieffer in Kieffer's key.[1] Differs as follows: Head and last five ab-

[1] Das Tier., Lief. 48 (1926) 310.

dominal segments black; thorax and first two abdominal segments rufous; frons carinate anteriorly on the sides; cheeks not carinate; antennæ (see fig. 1) reddish, the scape and pedicel yellow; mesonotum traversed longitudinally by many ridges; almost any of the furrows thus formed might be taken as the notauli; wings brownish, the venation pale brown; legs rufous, the anterior coxæ and all femora and tibiæ at base yellowish.

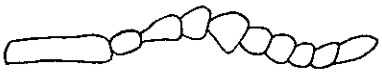

FIG. 1. *Scelio bicolor* sp. nov., antenna of male.

Abdomen as long as the head and thorax united; as wide as the thorax, two and one-fifth times as long as wide; all abdominal segments transverse, carinate.

Type locality.—Mindanao, Surigao (*Baker*), one male.

Type.—Catalogue No. 29209, United States National Museum.

Genus SPARASION Latreille

SPARASION PHILIPPINENSIS Kieffer.

Four females and sixty-two males from the following localities: Tangkulan, Bukidnon; Surigao, Mindanao; Kolambugan, Mindanao; Cuernos Mountains, Negros; and Mount Maquiling, Luzon.

Specimens of both sexes vary in length from 4.8 to 6.0 millimeters. Other variations are as indicated by Kieffer.[2]

Genus PROSPARASION Kieffer

PROSPARASION COERULEUM Kieffer.

I have before me ten females and fourteen males belonging to this species.

Some variation in punctuation and color is evident in both sexes. Seven males from Surigao have the scape reddish to reddish brown and the hind tibiæ light brown (always blackish at apex) to entirely dark brown or blackish. The frons may be nearly black with purplish or coppery reflections or bright greenish. The punctures on the frons and sides of pronotum vary slightly in density and size. Five males from Butuan and two from Surigao have the scape pale yellow to light brown and the hind tibia mostly light brown (always darker at apex). Variation in the color of the frons and in the punctuation in this series is as in the one just mentioned.

Variation in the female is very similar to that in the male. Two specimens from Butuan, one from Kolambugan, and one

[2] Das Tier., Lief. 48 (1926) 294.

from Surigao have the hind tibia dark only at extreme apex, and the frons greenish or blackish with purple reflections. Three specimens from Surigao have the hind tibia dark at apex and brownish otherwise. The frons is likewise greenish or blackish with purple reflections. Two specimens from northwestern Panay have the frons dark with violet reflections and the hind tibiæ entirely dark brown. The punctuation on the frons is somewhat less dense than in the other specimens.

Distribution.—Luzon, Mindanao, and Panay.

Genus MACROTELEIA Westwood

MACROTELEIA TERMINALIS sp. nov. Figs. 2 and 3.

Male.—Length 6.0 millimeters. Runs to *philippinensis* Kieffer in Kieffer's key.[3] Black; scape rufous; flagellum dark brown; legs yellow to reddish yellow, the last two joints of the hind tarsi brown; tegulæ rufous; wings brownish.

Head one and one-third times as wide as long, one and one-thirteenth times as wide as the thorax, slightly excavated posteriorly; antennæ (see fig. 2) covered with short semierect white hairs; facial impression deep, polished, margined laterally, about four times as wide as its distance from eye; frons and cheeks

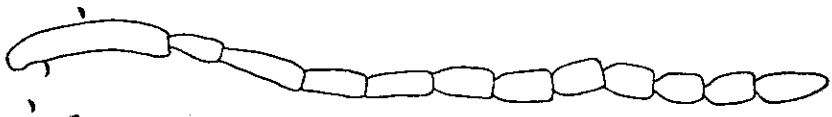

FIG. 2. *Macroteleia terminalis* sp. nov., antenna of male.

thickly and deeply punctate; vertex and occiput polished, with a few small scattered punctures; lateral ocelli less than their diameter distant from margin of eye; thorax shining, about one and one-half times as long as wide, slightly more than one and one-third times as wide as the abdomen (third segment), rather thickly covered with short white decumbent hairs; pronotum with a row of large punctures laterally; mesonotum sparsely covered with very small shallow punctures; notauli complete; propodeum pubescent, more thickly so laterally, with two high ridges which diverge anteriorly from the posterior margin of the segment; these two ridges are united posteriorly by a somewhat lower transverse ridge, this ridge coinciding with the posterior margin of the segment; propodeum emarginate posteriorly, the lateral angles more or less prominent; metacarpa a little over twice as long as the marginal vein, the latter distinctly longer

[3] Das Tier., Lief. 48 (1926) 521.

than the stigmal; wings not quite attaining the apex of the fifth abdominal segment; abdomen (see fig. 3) about two and one-third times as long as the thorax, with a median ridge extending from its base to the apex of the fifth tergite, and with a ridge on each side extending to the apex of the fourth tergite; first tergite with seven ridges, the five middle ones equidistant, the lateral ones farther away; second tergite with nine ridges, the seven middle ones about equidistant, the lateral ones somewhat farther away; the area just inside the lateral ridge on each side is somewhat wrinkled; third tergite also with nine ridges arranged as in the preceding segment except that the three on either side of the median one are more irregular and the outside one is not complete; the area just inside the lateral ridge on each side is as in the preceding segment, wrinkled; following segments longitudinally wrinkled and punctate, the punctures arranged more or less in lines; last tergite with two acute spines at the lateral posterior angles.

FIG. 3. *Macroteleia terminalis* sp. nov., dorsal view of abdomen of male.

Type locality.—Mindanao, Surigao (*Baker*), one male.

Type.—Catalogue No. 29196, United States National Museum.

MACROTELEIA INERMIS sp. nov. Fig. 4.

Male.—Length 4.5 millimeters. Runs to section 8 in Kieffer's key.[4] Black; scape brownish yellow; front coxæ rufous; trochanters yellow; rest of legs mostly brownish; tarsi darker; wings brownish.

Head one and one-half times as wide as long, one and one-thirteenth times as wide as the thorax, truncate posteriorly; facial impression as in *terminalis* sp. nov.; head punctured as in *terminalis* except that the vertex and occiput are provided with large scattered punctures; these punctures are arranged in a row just behind the posterior margin of the eye; antennæ (see fig. 4) covered with short semierect white hairs; lateral ocelli less than their diameter from the eye margin; thorax one and two-thirds times as long as wide, one and one-third times as wide as the abdomen (third tergite), pubescent as in *terminalis;* pronotum impunctate, with six large longitudinal ridges on each side; notauli complete, mesonotum shining, impunctate; propodeum emarginate posteriorly, with two low longitudinal ridges

[4] Das Tier., Lief. 48 (1926) 521.

running into the lateral posterior angles; these ridges are horizontal and parallel on basal one-third but slope downward and diverge from that point; there is no transverse carina or ridge connecting the longitudinal ones; metacarpa about twice as long as the marginal vein, the latter longer than the stigmal; abdomen in outline as in *terminalis*, a little over twice as long as the thorax, about four and one-half times as long as wide; first tergite as wide as long, as wide as the sixth; second tergite one and one-ninth times as long as wide, about one and three-seventh times as long as the first; third as wide as long, as long as the fourth is wide, slightly longer than the second or fourth; fourth a little wider than long, somewhat wider than the fifth, about as long as the second; fifth about one and two-fifths times as wide as long, as long as the first, as wide as the second; sixth very nearly twice as wide as long, about half as long as the fifth, four times as long as the seventh; seventh four times as wide as long, truncated at apex, without projections; a median ridge or carina extends from the base of the first tergite to the apex of the sixth; a ridge on each side (as in *terminalis*) extends from the base of the abdomen to a little beyond the middle of the fifth tergite; sculpture on the first and second tergites as in *terminalis;* third and fourth tergites each with nine more or less complete and regular longitudinal carinæ, the intervals not distinctly sculptured; fifth tergite also carinate but the intervals slightly roughened; sixth tergite rugose; last tergite without distinct sculpture.

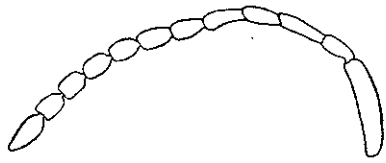

FIG. 4. *Macroteleia inermis* sp. nov., antenna of male.

Type locality.—Mindanao, Surigao (*Baker*), one male.

Type.—Catalogue No. 29195, United States National Museum.

DIAPRIIDÆ

Genus BELYTA Jurine

BELYTA MINDANAENSIS sp. nov.

Male.—Length 3.70 millimeters. Head 1.45 times as wide as long, as high as long; antenna of about the same width throughout, the joints becoming gradually shorter and thinner distally; scape about three times as long as wide, a little shorter than the third joint, thicker than the third; second joint as wide as the

third, transverse; third joint about five times as long as wide, about seven times as long as the second, shallowly excavated on one side at base; antennal joints closely covered with short, white hairs; thorax 1.35 times as wide as long, 1.22 times as wide as high, 1.25 times as wide as the head, 1.13 times as wide as the abdomen; thorax sparsely covered with long whitish hairs; abdomen 2.40 times as long as wide; petiole smooth, not carinate, 2.35 times as long as wide; second tergite 1.47 times as long as wide, 2.38 times as long as the petiole; second tergite polished, with two shallow foveæ basally; abdomen moderately densely covered with long white hairs; wings subhyaline, extending a little over 0.5 millimeter beyond the tip of the abdomen; radial cell open distally; first abscissa of the radius about half as long as the second; disco-cubitus present as a faint brownish line; black; mandibles rufous; tarsi yellow; antennæ piceous; legs brown.

Type locality.—Mindanao, Dapitan (*Baker*), one male.

Type.—Catalogue No. 29204, United States National Museum.

This seems to be the first species of *Belyta* described from the Oriental Region.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. *Scelio bicolor* sp. nov., antenna of male.
2. *Macroteleia terminalis* sp. nov., antenna of male.
3. *Macroteleia terminalis* sp. nov., dorsal view of abdomen of male.
4. *Macroteleia inermis* sp. nov., antenna of male.

YAWS LESIONS ON MUCOUS MEMBRANES AND A REPORT OF TWO CASES OF GENITAL MANIFESTATIONS OF FRAMBŒSIA TROPICA; AN INSTANCE OF GENITAL TRANSMISSION OF YAWS

By ISAO MIYAO[1]

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SEVEN PLATES AND ONE TEXT FIGURE

Very little information is gained regarding yaws manifestations on mucous membranes by consulting textbooks of tropical medicine. The limited space assigned to frambœsia tropica in the general plan of these books does not permit consideration of the details of the manifold clinical manifestations of yaws. Even handbooks are content with descriptions of the common cutaneous and bone lesions of yaws, yet the yaws manifestations on mucous membranes are as different in their clinical course and healing from the skin lesions as are the bone lesions of yaws.

I had the opportunity to observe yaws manifestations on the external genitals of a male patient. This case is of additional interest, because through sexual intercourse the disease was directly transmitted to the patient's wife. Initial yaws lesions on the external genitals resulted in the second patient. This offered an opportunity to study the development and course of yaws infection acquired in the same way that syphilis is acquired. Both patients are natives of Japan, a country located in a temperate zone where yaws is nonexistent, and they acquired the disease in a community where yaws is not endemic. As will be seen from the description and photographs the disease ran the same course as it does in natives of endemic districts and showed the same skin manifestations.

A CASE OF GENITAL MANIFESTATION OF YAWS IN A MALE PATIENT

Patient 1, K. K., 33 years old, Japanese, male, residing exclusively in Manila for the last six years. As the owner of a

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refreshment store the patient naturally came in contact with transient provincial inhabitants.

In 1926 the patient had a sore on the penis. The attending physician cauterized the sore and it healed in one week. In the same year the patient contracted gonorrhœa.

November 4, 1928, the patient married a Japanese woman, 29 years old, who had recently arrived in Manila directly from Japan. Previous to his marriage and on October 2, 1928, the patient felt fever, pain in the joints, and loss of appetite. The fever lasted five days. When the fever subsided the patient noticed an erruption on the thighs, the legs, the palms of the hands, and the face around the nostrils. The erruption on the body gradually subsided, but the lesions on the face persisted and reached such a degree that the patient consulted a physician. He was given an ointment to apply locally on the lesions.

The patient was seen by me January 3 for the first time. He complained of considerable itching and lack of sleep and was very much disturbed mentally by the loathsome appearance of the face lesions (see Plate 1). Since the end of December the patient had felt difficulty in urinating and at times was unable to pass urine.

Upon clinical examination the following findings were made: A young man of medium stature, rather poorly nourished and slightly anæmic. On the face, the hairy part of the head, the neck, and the elbows there were isolated and grouped skin lesions, slightly elevated and covered with dark brittle crusts. When the crusts were removed the lesions showed oozing and slight bleeding. One lesion located in the neighborhood of the left corner of the mouth extended onto the mucous membrane of the lip. The skin lesion was covered with a crust, but the part of it that had crossed the mucocutaneous border and was located on the lip was moist and showed considerable oozing. Around the anus a wide condylomalike moist lesion covered with oozing lymph and pus was found. On the left scrotum there was a single isolated yaw covered with crust. The left side of the penis showed an extensive, confluent, framboesic skin lesion which extended by continuity on the prepuce and from there spread directly onto the glans penis. The yaws lesion involved more than half of the surface of the glans and was lobulated; the surface was uneven and oozing. There was no crust formation due to the long prepuce which covered the entire glans and consequently the lesion. The

base of the lesion showed soft œdema which yielded to pressure leaving a distinct impression at the site of pressure. The lesion involved the frenulum and the adjacent part of the orifice of the urethra. The frenulum and the urethral orifice were distinctly œdematous in the manner usually found in acute gonorrhœa. The discharge from the urethra was scanty and seromucous. The inguinal and the supratrochlear lymph glands were enlarged, firm, and indolent. This enlargement persisted for some time after complete clinical and serological cure was achieved. On the palms of the hands a typical psoriasis palmaris was found.

CLINICAL DIAGNOSIS

Generalized early yaws, psoriasis palmaris, yaws manifestation on the mucocutaneous border of the mouth, the anus, and the prepuce, extending and involving the glans penis and the orifice of urethra.

As a confirmation of the clinical diagnosis one Philippine monkey was inoculated intradermally with the material obtained from the cutaneous lesions of the patient. Likewise a rabbit was inoculated intratesticularly with the same material. The monkey developed a typical yaw at the point of inoculation, and the strain could be maintained in monkeys. The rabbit showed no lesion, and repeated microscopic examination of the inoculated testicle failed to reveal treponemas. The rabbit was kept under observation for three months. This animal test shows that the infection in the patient was yaws and not syphilis.

TREATMENT

January 3, 1929, the patient received 0.45 gram of neosalvarsan intravenously. Next morning the temperature was slightly elevated and the patient complained of a headache and a tired feeling all over the body. As can be seen in Plate 2, four days after the first injection of neosalvarson the cutaneous lesions became distinctly flattened, dry, and pigmented. The lesions on the mucous membranes, that is to say, the lip, anus, and glans penis, remained unchanged.

January 14, 1929, the skin lesions were reduced to dark pigmented spots. The condylomalike lesion on the skin around the anus had healed leaving an extensive dark pigmented area surrounding the anus. The lesion on the lip and the one on the glans penis showed a very slight healing by this time. The difficulty in urinating had subsided.

January 17, 1929, the patient received 0.45 gram of neosalvarsan intravenously.

January 19 the lesion in the corner of the mouth was found somewhat smaller, appearing as a white spot with a moist surface. The lesion on the glans penis was found healing in some parts but not in the entire extent of the original lesion. The healing parts of the lesions appeared as superficial milk-white scars extending to the prepuce.

January 26 the third injection of 0.45 gram of neosalvarsan was given intravenously. The pigmentation of the skin at the places of former skin lesions had faded considerably by this time.

The fourth intravenous injection of 0.45 gram of neosalvarsan was administered February 11, 1929. The cutaneous pigmentation had disappeared by this time. The lesion on the glans penis appeared very flat, and showed a dry surface. The soft œdema at the base of the lesion and at the orifice of the urethra had disappeared.

The fifth injection of the same dose of neosalvarsan as on previous occasions was given February 26, 1929.

Two more injections of 0.45 gram each were administered; one March 19 and the other April 2, 1929.

By May 21 the lesion on the glans penis was completely healed leaving smooth superficial shiny scars and a partial phimosis.

A CASE OF GENITAL MANIFESTATION OF INITIAL YAWS IN A FEMALE PATIENT

Patient 2, S. K., 30 years old, Japanese woman, wife of patient 1, K. K. Passed history unimportant. Denies syphilis. Arrived in Manila from Japan and married patient 1 November 4, 1928.

Since the first of March, 1929, the patient noticed leucorrhœa and burning sensation in vagina. March 9 of the same year the patient had fever, general malaise, and loss of apetite. These complaints gradually subsided and the patient noticed two small lesions on the right labium majus. The patient was first seen by me March 12, 1929.

A young woman of medium stature, well nourished. Upon inspection two lesions were discovered on the external genitals; the rest of the body integument was found free from lesions. The lesions on the external genitals (Plate 7, fig. 1, lesions 1 and

2) were small superficial, slightly elevated lesions surrounded by a hyperæmic zone. The surface of the lesions was uneven and the borders were irregular. The lesions were moist, covered with oozing lymph and pus. Their exact location and relative size can be seen on Plate 7, fig. 1, lesions 1 and 2. The inguinal glands on the right side were swollen and indolent. There was a purrulent discharge found in the vagina and in the orifice of the uterus.

Serelogic examination (see chart 2) performed March 12, 1929, resulted in positive Wassermann (++) and Kahn (++) tests. The same day the patient received an intravenous injection of 0.15 gram of neosalvarsan.

Inspection a few days after the first injection of neosalvarsan revealed that the two lesions on the external genitals were larger than before.

March 14 there was a new lesion noticed at the introitus of the anterior vaginal wall below the orifice of the urethra.

The patient was inspected daily, and March 14 a generalized eruption of yaws lesions was noticed for the first time. The metastatic lesions appeared as small copper-colored papules measuring from 1 to 3 millimeters in diameter. Three were located on the flexor aspect of the right forearm, one on the right elbow, two on the right palm, two on the dorsal surface of both hands, three on the sole of the left foot, and two on the dorsal surface of each foot.

March 17 new lesions were found on the genitals. One was located between the clitoris and the urethral orifice (Plate 7, fig. 2, lesion 2) and one (Plate 7, fig. 2, lesion 4) in the neighborhood of lesion 2 on the upper part of the right labium majus.

March 21 the genital lesions already described appeared larger and were covered with secretion. One new lesion was found on the posterior wall of the introitus vagina opposite to that noticed on the 14th. Furthermore, two new small lesions were noted located on the left labium minus right opposite the first lesion on the right labium majus. They were small, diffuse, and flat without induration, and covered with secretion. The itchy sensation and leucorrhœa reappared one week after the first injection of neosalvarsan. The flat copper-colored papule and superficial desquamation on the palms of the hands persisted to March 25, but the rest of the cutaneous lesions were found dry and pigmented by that time.

The third injection of 0.45 gram of neosalvarsan was given March 30. The lesion on the genitals appeared dry, except the two on the labia minora which were still moist and secreting.

By April 30 the leucorrhœa had diminished considerably but the itching still persisted. The original lesions on the labium majus had healed by this time leaving very fine superficial shiny scars.

April 8 another intravenous injection of 0.45 gram of neosalvarsan was given. The dark pigmentation on the palms of the hands and the soles of the feet still persisted, but the rest of the skin lesions had disappeared by this time leaving no trace. As on previous occasions when neosalvarsan was given, the patient complained of considerable itching at the places of healed or healing yaws lesions, both on the mucous membranes and the skin.

May 3 the persisting lesions on the external genitals still were present, but the pigmentation on the palms of the hands and the soles of the feet had disappeared. It is noteworthy that at this time, as is evident from the attached serologic chart, both the Wassermann and the Kahn reactions were negative while the lesions on the mucous membranes, though healing, still persisted.

May 4 the patient received the last intravenous injection of 0.45 gram of neosalvarsan.

Inspection, May 10, revealed that the lesions on the genitals had completely healed, leaving very superficial shiny scars. Clinical and serologic cure of this yaws patient was achieved by this time.

SUMMARY OF THE TWO CASES OF GENITAL MANIFESTATIONS OF YAWS, AN INSTANCE OF GENITAL TRANSMISSION OF YAWS

A brief history of two cases of genital yaws, one male and one female, is given because of the scarcity in the literature of reports concerning yaws manifestations on the genitals, particularly of the male, and a complete absence as far as we were able to search in the available literature, of a description of the course and healing of genital yaws lesions; furthermore, as a direct demonstration of the existence, though rare, of transmission of yaws by sexual intercourse. The distinct differences between the little-known early genital yaws and the well-known early genital syphilis are brought out and illustrated. Both patients, herewith reported, where natives of a yaws-free country and contracted yaws in a community where this disease is

not endemic; the disease ran the same course and its manifestations were the same as occur in yaws-endemic communities.

A phenomenon in human yaws, which resembles the well-known Herxheimer's reaction in syphilis, is brought out in this observation; namely, the sudden exacerbation of the genital yaws lesions following the first intravenous application of neosalvarsan and the recurring itching sensation at the places of healing or healed skin lesions.

The clinical characteristics of yaws lesions located on mucous membranes are discussed.

DISCUSSION

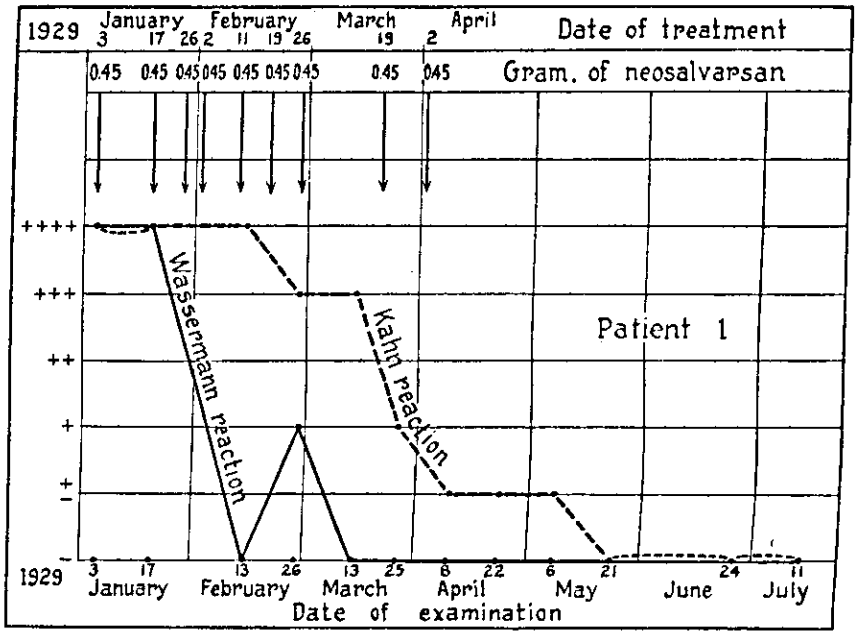
Reports in the literature concerning yaws lesions on mucous membranes are very few. Such as were found referred mostly to the peculiar form of yaws known as gangosa. It appears that the most extensive account of yaws lesion on mucous membranes is that of Noel [2] in the Cameroons. To quote from the review:[3]

> The author finds that the lesions of mucosa in yaws are neglected in the literature. . . . Almost alone Castellani has given some description of them.

Noel has studied one hundred cases in the Cameroons. Apart from the genital and anal regions, the secondary lesions of yaws were found in twenty-two cases on the mucosa of the mouth, in nineteen on the nose, and in four on the conjuctiva.

These were evidently metastatic lesions. Van Niseten,[4] however, describes a case of yaws with the initial yaws lesion on the prepuce. Hallenberger [5] in Africa speaks of cases of genital yaws. Lopez-Rizal and Sellards [6] in the Philippines illustrate three cases of genital manifestations of yaws, one in a woman (Plate 2, fig. 1) where the condylomalike lesion around the anus spread onto the entire external genitals; another in a man where isolated yaws are found on the scrotum, the thighs, and the penis. The photograph is not clear enough to decide whether the lesions were located on the prepuce or on the glans penis. The third picture (figs. 3 and 4) of a yaws patient in the lowlands shows isolated yaws lesions on the cutaneous part of the external

[2] Ann. de Derm. et de Syph. VI 2 (1921) 72–81.
[3] Trop. Dis. Bull. 18 (1921) 251.
[4] Ann. Soc. Belge de Med. Trop. Brussels 23 (1922) 263–267.
[5] Arch. für Schiffs- und Tropen-Hyg. 20 (1916) Beih. 3, pl. 1, fig. 4; pl. 8, figs. 44 and 46.
[6] Philip. Journ. Sci. 30 (1926) 497–505.


1929 January February March April Date of treatment
3 17 26 2 11 19 26 19 2
0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 Gram. of neosalvarsan
++++
+++
++
+
+
−
Wassermann reaction
Kahn reaction
Patient 1
1929 3 17 13 26 13 25 8 22 6 21 24 11
January February March April May June July
Date of examination

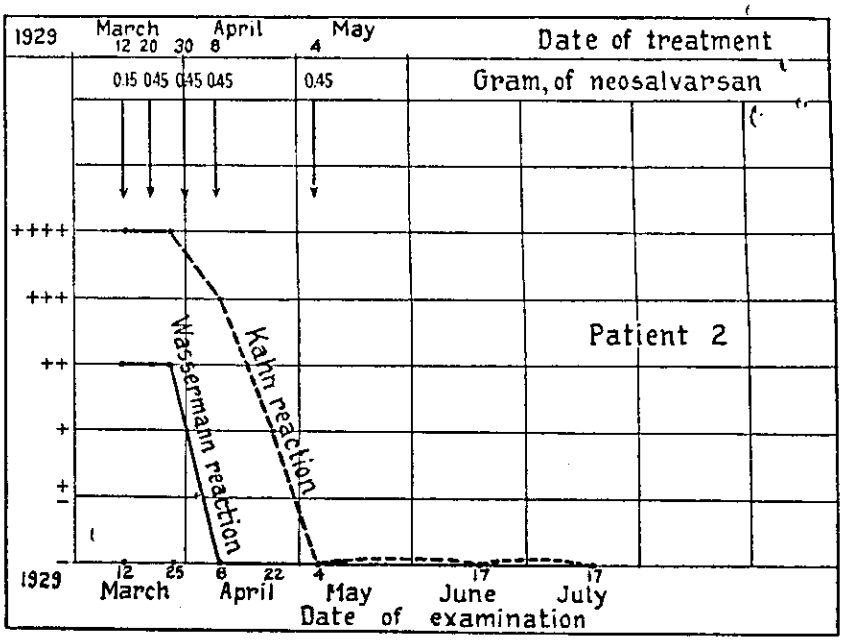


FIG. 1. Serologic charts of patients 1 and 2.

genital of a little girl. All these lesions are unquestionably metastatic generalized lesions. Devota[7] describes two cases of phimosis in young boys following yaws. He states that these were the only cases of such a condition seen among 12,000 cases of yaws in Kelantan. It is possible that genital yaws lesions are commoner than it is generally believed, but a thorough clinical examination of cases in heavily infested countries is very seldom performed as there are manifest lesions on other parts of the body that are fully sufficient for the diagnosis of yaws without thoroughly investigating the less-common manifestations. My cases, therefore, are placed on record to show the course of these lesions and their behavior toward the specific treatment.

The two charts showing the results of repeated serologic examination of the two patients show the sudden drop in positive Wassermann in both cases following the administration of neosalvarsan. They show that the Kahn reaction was more pronounced than the Wassermann reaction in the second patient, therefore, in the earlier stage, and that it persisted longer than the Wassermann reaction in both cases. As mentioned in the description of the course of the treatment the genital lesions persisted for some time after serologic cure had been achieved and after the skin lesions had completely healed.

CONCLUSIONS

Genital yaws lesions like those on other mucous membranes are extensions of framboesic skin lesions located at the body orifices. Their clinical and other characteristics are distinct from contemporary yaws lesions located on firm skin and easily differentiated from genital lesions of syphilis. Like early yaws lesions located on other mucous membranes the genital yaws lesions are far less amenable to specific treatment than the coexisting skin lesions of yaws. A phenomenon was observed in human yaws which resembles the Herxheimer's reaction in syphilis.

ACKNOWLEDGMENT

Thanks are due to Dr. Otto Schöbl, chief of the division of biology and serum laboratory, Bureau of Science, for many valuable suggestions and other assistance rendered during this observation, and to Dr. Onofre Garcia for his courtesy in performing the serologic reactions with the patients' blood.

[7] Malayan Med. Journ. Singapore 1 (1926) 28. Quoted from the Trop. Dis. Bull. 23 (1926) 929.

ILLUSTRATIONS

PLATE 1

Typical early metastatic yaws in the face. This photograph was taken When patient 1 was first seen, January 4, 1929.

PLATE 2

The rapid healing of the lesions four days after the first injection of 0.45 gram of neosalvarsan, January 8, 1929.

PLATE 3

Appearance of patient 1 at the time of complete cure. The photograph was taken March 27, 1929.

PLATE 4

The genital yaws manifestation as it appeared January 14, 1929.

FIG. 1. The spreading superficial lobulated lesion on the glans penis.

2. The extensive skin lesion on the left side of the penis directly extending over the prepuce to the glans penis. An isolated yaw on the left scrotum.

PLATE 5

The skin lesion on the penis (fig. 1) and the solitary yaw on the left scrotum (fig. 2) have regressed considerably after two injections of neosalvarsan, while the lesion on the glans penis was still progressing. The photograph was taken fifteen days after the first injection of neosalvarsan.

PLATE 6

In healing as a consequence of treatment the lesion preserved the typical granulomatous appearance as evident from the lobulated surface (fig. 1). Fig. 2 shows the last stage in healing of the lesion. Epithelisation is covering the last remnants of the lesion leaving superficial shiny scars of milky color.

PLATE 7

Diagrams showing the location of the initial yaws lesions on the genitals of patient 2.

TEXT FIGURE

FIG. 1. Serologic charts of patients 1 and 2.

PLATE 1.

PLATE 2.

PLATE 3.

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PLATE 4.

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PLATE 5.

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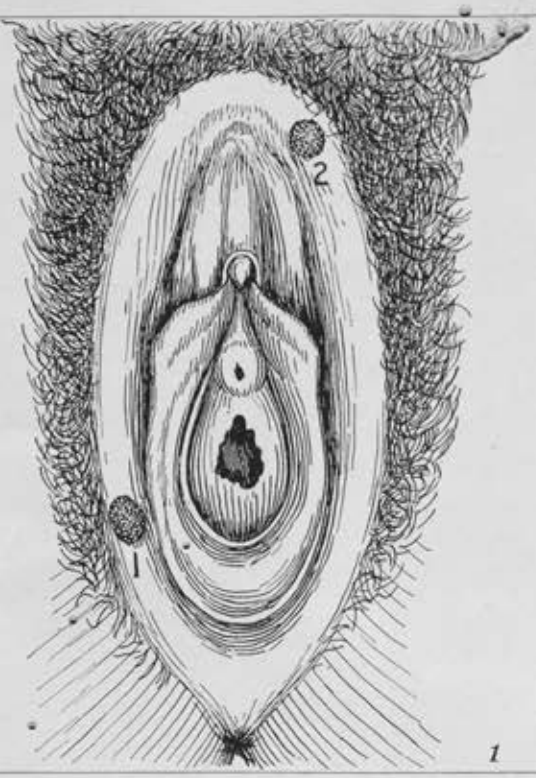
PLATE 6.



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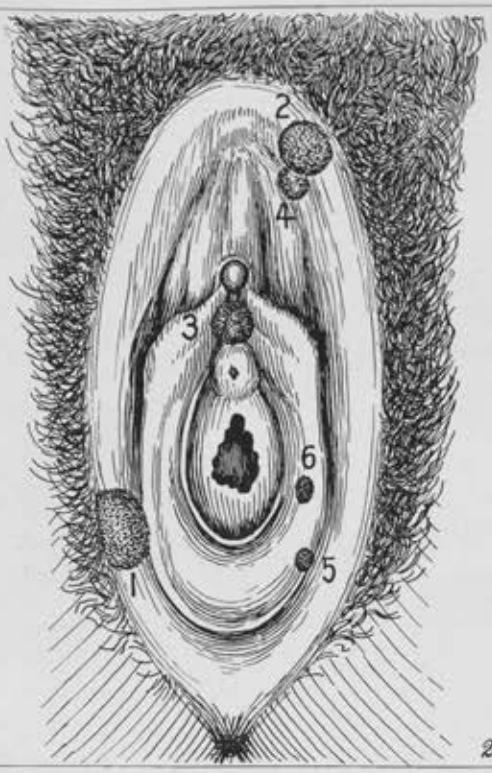

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PLATE 7.

AN UNUSUAL LATE, FUNGOID, AND ULCERATIVE YAWS LESION IN AN EXPERIMENTAL MONKEY

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Of the Division of Biology and Scrum Laboratory, Bureau of Science Manila

THREE PLATES

On account of the scarcity in the literature of reports concerning late yaws lesions in experimental animals the case presented herewith may be of interest to the student of tropical medicine.

HISTORY OF THE LESION

November 26, 1926, a normal healthy Philippine monkey was inoculated in both eyebrows with yaws material containing numerous treponemas. The material used for inoculation was obtained from a lesion produced in another Philippine monkey by intradermal inoculation. (The strain of Treponema frambœsiæ, the Cadangan strain, was isolated in the Philippines March 4, 1925, and passed through several monkeys.[2]) December 22, 1926, lesions developed on both eyebrows. They were clinically recognizable as primary yaws lesions. They ran the usual course, and January 26, 1927, a dry scabby lesion was found over the left eyebrow and extending down the bridge of the nose. Treponemas were found in these lesions. February 7, 1927, treatment with neosalvarsan began; the animal received eight injections of the drug, the total amount administered was 0.09 gram. Ten days after the first injection of the drug a slight redness and a slight scaling over the left eyebrow were still noticeable; after the second injection, March 5, 1927, no sign of yaws was noticed. This normal condition of the animal continued, and February 15, 1928, it was inoculated again on both eyebrows with yaws material collected from a yaws-infected monkey. The inoculation was repeated April 11, 1928; nothing unusual had been noticed in the meanwhile at the place of the

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[2] For detailed history of this strain see Philip. Journ. Sci. 35 (1928) 229.

second inoculation. June 25 of the same year there was no sign of yaws noticed upon inspection. Between June 25 and July 28 there developed on the left eyebrow a lesion clinically recognizable as yaw. By July 28, 1928, it presented a granulomatous growth on the left eyebrow and extended on all sides by continuity including the upper portion of the left lid. It was round, showed a central depression, and the margins were granulomatous and elevated. The skin surrounding the lesion showed considerable œdema. The condition as encountered July 28, 1928, can be seen in Plate 1, fig. 1. From that time the lesion spread on all sides, gradually assuming more and more the shape of a fungoid lesion with excessive granulations and by October 24, 1928, the great fungoid lesion involved the entire upper lid and practically the entire eyebrow, thus closing the eye. The scabs were few and the oozing slight. It is apparent from the photograph (Plate 1, fig. 2) that the entire skin was affected, and there was no tendency on the part of the lesion to heal in the center as is usual in early yaws lesions.

By November 19, 1928, the lesion was found somewhat flattened and the surrounding normal skin became visible under the cauliflowerlike margins of the lesion (Plate 2, fig. 1).

Plate 2, fig. 2, shows the lesion as it appeared December 4, 1928. The fungoid aspect of the lesion disappeared, and the surface of the defect proper became flat. It was surrounded by considerable œdema.

By December 17, 1928, spontaneous healing had progressed considerably. The lesion appeared much smaller, and the healing from the periphery, by scar formation, became evident. Considerable pigmentation remained in the area of the skin previously involved by the lesion (Plate 3, fig. 1).

The retracting scar (Plate 3, fig. 2) that formed by healing of the lesion produced an ectropium and coloboma of the upper lid. This is particularly evident at the point where the cleftlike defect of the upper lid is located. The scars reached to the bone showing, as does the defect in the lid, that deep parts of the lid tissue were affected.

Throughout the duration of the late lesion weekly examinations were made by dark-field microscope. Treponemas were never found in the lesion.

This case is another example of the great variety of yaws lesions that can be produced experimentally in Philippine mon-

keys. It is an addition to the experimental evidence already presented [3] that the yaws infection in monkeys under certain experimental arrangement closely duplicates the clinical yaws lesions as known in man. Identical forms of fungoid and ulcerative lesions as observed in this monkey are rather common in man even though located on other parts of the body than the eyebrow.

Thanks are due to Dr. Otto Schöbl, of the Bureau of Science, for courtesies received in carrying out this observation.

[3] Loc. cit.

ILLUSTRATIONS

PLATE 1

FIG. 1. The beginning of the late yaws lesion.

2. The lesion has spread over the entire left eyebrow and the lid and assumed a cauliflower appearance. The extent and the weight of the lesion closed the left eye.

PLATE 2

FIG. 1. The gradual regressing of the fungoid lesion is shown.

2. Further progress in the regressing of the lesion and beginning healing from the periphery by retracting scars.

PLATE 3

FIG. 1. The healing has advanced and the scar formation shows the depth of the original lesion.

2. The ultimate outcome of the healing. The scars retracting the upper lid and the extensive pigmentation within the area of the former lesion are shown.

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PLATE 1.

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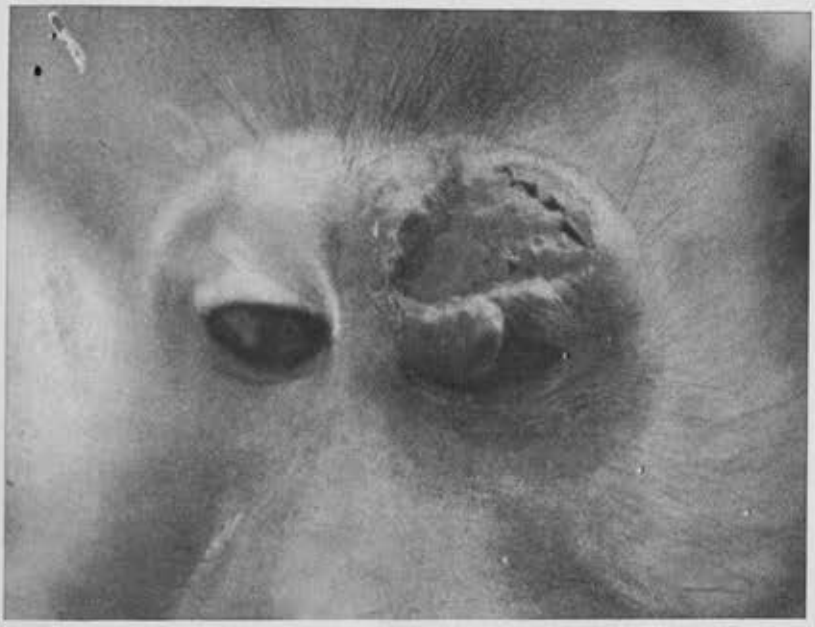

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PLATE 2.

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PLATE 3.

DIATOMS FROM DALAI-NOR LAKE, EASTERN MONGOLIA

By B. W. SKVORTZOW

Of Harbin, China

TWO PLATES

A certain amount of work has been done on the diatoms of the various parts of Siberia, but the fresh-water algæ of the Mongolian plain have been almost completely overlooked. Contributions on the algal flora of Mongolia and, particularly, of South Siberia have been published by R. Gutvinski, E. Oestrup, V. Dorogostaiski, K. Meyer, H. Printz, and by the author of this note.

The algæ which form the subject of this memoir were obtained from material collected by Mr. P. A. Pavlov, member of Manchurian Research Society of Harbin, in the northern part of Dalai-nor Lake in August, 1926. He kindly placed at my disposal some twelve tubes of the material collected from various parts of this lake. The diatoms observed were essentially brackish-water forms, some of which are known from the Aral basin of Turkestan. One striking feature is the presence in Dalai-nor of *Coscinodiscus* species which has been known only from the sea and large lakes. The forms of diatoms found in the collection are herein enumerated. This note is illustrated with microphotographs and diagrams by the author.

MELOSIRA ISLANDICA O. Müll. status β.

Length, 0.034 millimeter; breadth, 0.0153; striæ, 18 in 0.01 millimeter.

MELOSIRA BAIKALENSIS (K. Meyer) Wislouch?

Length, 0.027 millimeters; breadth, 0.0102; striæ, 6; puncta, 6 in 0.01 millimeter.

CYCLOTELLA MENEGHINIANA Kütz.

Frustules, 0.017 millimeter in diameter.

CYCLOTELLA KÜTZINGIANA Thw. Plate 1, fig. 4.

Frustules, 0.018 millimeter in diameter.

STEPHANODISCUS ASTRAEA (Ehrenb.) Grun. Plate 1, fig. 1.

Diameter, 0.042 to 0.05 millimeter. This large diatom is known from many lakes of Europe, Caucasus, Ireland, and Canada, and was recently found in North Russia, in Onega and Lososinski Lakes (Wislouch and Kolbe).

COSCINODISCUS LACUSTRIS Grun. var. HYPERBOREUS Grun.

Frustules circular. Diameter, 0.03 to 0.0425 millimeter. Markings angular, 10 in 0.01 millimeter; subequal to the circlet of apiculi, thence more minute to the border; apiculi form a single circlet. Habit: Franz-Josef Land, North Siberia, Karisch Sea, Cape Wankarema, Aral Sea, and Balchasch Lake of Turkestan.

COSCINODISCUS LACUSTRIS Grun. var. SEPTENTRIONALIS Grun. Plate 1, figs. 2 and 3.

Diameter, 0.0187 to 0.029 millimeter. Surface with a short transverse plication. Markings, 8 to 9 in 0.01 millimeter; decreasing somewhat near the border. Habitat: Franz Josef Land, Karisch Sea, Jamal, Cape Wankarema, North Siberia, Balearic Islands, Canton River, Whampoa, Balchasch Lake, and Aral Sea.

FRAGILARIA CONSTRUENS (Ehrenb.) Grun.

A. Schmidt, Atlas Diat., pl. 296, figs. 27 and 41.

Length, 0.0204 millimeter; breadth, 0.007; striæ, 9 to 10 in 0.01 millimeter.

ASTERIONELLA FORMOSA Hassel. Plate 2, fig. 1.

Length, 0.068 to 0.0765 millimeter; breadth, 0.0017 to 0.002.

SYNEDRA LIMNETICA Lemm. Plate 2, fig. 2.

A. Schmidt, Atlas Diat., pl. 306, figs. 14–16.

Valve linear. Length, 0.0187 to 0.0204 millimeter; breadth, 0.0017; striæ, 9 to 10 in 0.01 millimeter.

SYNEDRA PULCHELLA Kütz.

Length, 0.081 millimeter; breadth, 0.0051.

EUNOTIA MONODON Ehrenb.

Length, 0.098 millimeter; breadth, 7.

CALONEIS SILICULA Ehrenb. var VENTRICOSA (Ehrenb.) Donk.

Length, 0.0425 millimeter; breadth, 0.0068.

NEIDIUM PRODUCTUM W. Smith.

Length, 0.064 millimeter; breadth, 0.018.

ANOMOEONEIS POLYGRAMMA Ehrenb. Plate 1, figs. 8–10.

Length, 0.081 to 0.144 millimeter; breadth, 0.027 to 0.037; striæ, 16 in 0.01 millimeter. Habitat: Brackish water; Sweden, Europe, Siberia, and America.

ANOMOEONEIS SPHAEROPHORA Kütz. Plate 2, fig. 4.

Length, 0.073 millimeter; breadth, 0.019; striæ, 15 in 0.01 millimeter. Habitat: Fresh or slightly brackish water; Sweden, England, Switzerland, East Indies, New Zealand, Illinois, and Ecuador.

ANOMOEONEIS EXILIS (Kütz.) Grun.

Length, 0.017 to 0.0187 millimeter; breadth, 0.0042 to 0.0051. Habitat: Fresh and, frequently, slightly brackish water.

NAVICULA CINCTA Ehrenb. var. HEUFLERI Grun.

Length, 0.019 millimeter; breadth, 0.0058.

NAVICULA GREGARIA Donk.

Length, 0.04 to 0.042 millimeter; breadth, 0.00085 to 0.01.

NAVICULA ELSAE THUM Pant. Plate 2, fig. 5.

Length, 0.095 millimeter; breadth, 0.023 to 0.025; striæ, 7 to 8 in 0.01 millimeter. Habitat: Balaton Lake, Europe.

NAVICULA ELSAE THUM forma CRATICULARIS Pant.

Length, 0.059 millimeter; breadth, 0.0154. Habitat: Balaton Lake, Europe.

NAVICULA DICEPHALA (Ehrenb.) W. Smith.

Length, 0.032 millimeter; breadth, 00.1; striæ, 11 in 0.01 millimeter.

NAVICULA GASTRUM Ehrenb. forma. Plate 2, fig. 3.

Length, 0.034 millimeter; breadth, 0.013; striæ, 9 in 0.01 millimeter.

NAVICULA PERROTETTII Grun. Plate 2, fig. 6.

Length, 0.17 millimeter; breadth, 0.042. Habitat: Slightly brackish water; Italy, Philippines, Java, New Guinea, Senegal, Brazil, and United States of America.

NAVICULA CUSPIDATA Kütz. forma SUBROSTRATA Dipp.

Length, 0.081 millimeter; breadth, 0.025; striæ, 17 in 0.01 millimeter.

NAVICULA CUSPIDATA forma CRATICULARIS F. Herib.

Length, 0.195 millimeter; breadth, 0.045; striæ, 18 in 0.01 millimeter.

NAVICULA CUSPIDATA var. AMBIGUA Ehrenb.

Length, 0.064 to 0.068 millimeter; breadth, 0.015 to 0.018; striæ, 17 to 18 in 0.01 millimeter.

PINNULARIA MICROSTAURON Ehrenb. Cleve A. EU-MICROSTAURON A. Mayer var. GENUINA A. Mayer.

Length, 0.0059 to 0.064 millimeter; breadth, 0.01 to 0.0013; striæ, 15 in 0.01 millimeter.

PINNULARIA MAJOR Kütz. var. LENEARIS Cleve.

Length, 0.113 millimeter; breadth, 0.018; striæ, 7 in 0.01 millimeter.

STAURONEIS ANCEPS Ehrenb. var. HYALINA Br. and Perag.

Length, 0.039 millimeter; breadth, 0.009.

PLEUROSTAURON SMITHII Grun.

Length, 0.119 millimeter; breadth, 0.022.

SCOLIOPLEURA PAVLOVI sp. nov. Plate 1, fig. 11.

Valvis elongatis, 0.042 ad 0.0612 mm longis, 0.0136 ad 0.022 mm latis, cum polis subacutis et rotundatis. Rhaphe et area axillaris inflexis. Striæ punctatæ in lineas longitudinales dispositæ, 13 ad 14 in 10 micron, cum vitæ dilatata longitudinali interruptæ. E grege *S. peisonis* Grun.

CYMBELLA ASPERA Ehrenb. var. TRUNCATA Rabenh.

Length, 0.112 millimeter; breadth, 0.025; striæ, 9 in 0.01 millimeter.

CYMBELLA CISTULA (Hempr.) Van Heurck var. MACULATA Kütz.

Length, 0.059 millimeter; breadth, 0.018; striæ, 9 in 0.01 millimeter.

CYMBELLA CISTULA (Hempr.) Van Heurck var. EUCISTULA A. Mayer forma MINOR Van Heurck.

Length, 0.052 millimeter; breadth, 0.017.

AMPHORA OVALIS Kütz. var. PEDICULUS Kütz. forma MONGOLICA forma nova. Plate 2, fig. 7.

Valvis parvula, ventre inflexis, dorso convexis, ad polos attenuatis et rotundatis, 0.021 ad 0.022 mm longis, 0.0068 ad 0.007 mm latis. Striæ 15 in 10 micron.

AMPHORA OVALIS var. TYPICA Cleve.

Length, 0.0425 millimeter; breadth, 0.01; striæ, 12 in 0.01 millimeter.

AMPHORA COFFAEIFORMIS Ag. var. PERPUSSILLA Grun.

Length, 0.014 to 0.016 millimeter; breadth, 0.0025 to 0.0035. Habitat in brackish water.

GOMPHONEMA AUGUR Ehrenb.

Length, 0.054 millimeter; breadth, 0.13; striæ, 8 in 0.01 millimeter.

RHOICOSPHENIA CURVATA (Kütz.) Grun.

Length, 0.037 to 0.039 millimeter.

TRYBLIONELLA DEBILIS Arnott and Rylands. Plate 2, fig. 8.

Length, 0.027 millimeter; breadth, 0.01; striæ, 20 in 0.01 millimeter.

TRYBLIONELLA TRYBLIONELLA Hantzsch. Plate 2, fig. 12.

Length, 0.076 millimeter; breadth, 0.018; striæ, 11 in 0.01 millimeter.

TRYBLIONELLA TRYBLIONELLA var. LEVIDENSIS W. Smith. Plate 2, fig. 9.

Length, 0.047 millimeter; breadth, 0.011 to 0.012.

TRYBLIONELLA ACUMINATA Smith. Plate 2, fig. 10.

Length, 0.045 millimeter; breadth, 0.012.

NITZSCHIA COMMUNIS Rabenh. var. OBTUSA Grun.

Length, 0.025 millimeter; breadth, 0.0034; striæ, 17 in 0.01 millimeter.

NITZSCHIA PALEA Kütz. var. FONTICOLA Grun.

Length, 0.0136 millimeter; breadth, 0.0028; striæ, 20 in 0.01 millimeter.

NITZSCHIA FRUSTULUM (Kütz.) Grun. var. PERMINUTA Grun.

Length, 0.012 millimeter; breadth, 0.0025; striæ, 21 in 0.01 millimeter.

NITZSCHIA RIGIDA Kütz. Plate 2, fig. 13.

Length, 0.081 millimeter; breadth, 0.0034; striæ, 15 in 0.01 millimeter.

NITZSCHIA APICULATA (Greg.) Grun.

Length, 0.047 to 0.049 millimeter; breadth, 0.005 to 0.006; striæ, 17 to 20 in 0.01 millimeter.

NITZSCHIA OBTUSA Smith. Plate 1, fig. 5.

Length, 0.112 to 0.144 millimeter; breadth, 0.008 to 0.011; striæ, 5 to 6.5 in 0.01 millimeter.

HANTZSCHIA AMPHIOXYS (Kütz.) Grun.

Length, 0.047 millimeter; breadth, 0.0068; striæ, 17 in 0.01 millimeter.

HANTZSCHIA AMPHIOXYS var. GRACILIS Hustedt.

Length, 0.11 millimeter; breadth, 0.012; striæ, 18 in 0.01 millimeter.

CYMATOPLEURA ELLIPTICA Bréb. Plate 1, fig. 12.

Length, 0.102 to 0.136 millimeter; breadth, 0.042 to 0.072.

EPITHEMIA ZEBRA (Ehrenb.) Kütz.

Length, 0.085 millimeter; breadth, 0.01.

EPITHEMIA TURGIDA (Ehrenb.) Kütz.

Length, 0.0595 millimeter; breadth, 0.015.

EPITHEMIA ARGUS (Ehrenb.) Kütz.

Length, 0.062 millimeter; breadth, 0.01.

RHOPALODIA VENTRICOSA (Grun.) O. Müll.

Length, 0.062 millimeter; breadth, 0.0085.

SURIRELLA OVATA Bréb.

Length, 0.057 to 0.066 millimeter; breadth, 0.03; striæ, 4 in 0.01 millimeter.

SURIRELLA OVATA var. OVATA Kütz. Plate 1, figs. 6, 7, 13, and 14; Plate 2, fig. 15.

Length, 0.03 to 0.066 millimeter; breadth, 0.025 to 0.049; costæ, 3 to 4 in 0.01 millimeter; striæ, 15 to 20 in 0.01 millimeter.

SURIRELLA OVATA var. OVATA forma MONGOLICA forma nova. Plate 2, fig. 14.

Valvis ovalis, 0.127 mm longis, 0.064 mm latis, polo superiori modice attenuato, obtuso, inferiori late-rotundato. Costis longis, arcuatis, 4 in 10 micron, puncta 12 in 10 micron.

SURIRELLA OVATA var. OVATA forma CURTA forma nova. Plate 2, fig. 11.

Valvis curtis, rotundatis, 0.027 mm longis, 0.022 mm latis. Costæ 6 in 10 micron.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Stephanodiscus astraea* (Ehrenb.) Grun.
FIGS. 2 and 3. *Coscinodiscus lacustris* Grun. *var. septentrionalis* Grun.
FIG. 4. *Cyclotella kützingiana* Thw.
5. *Anomoconeis polygramma* Ehrenb.
FIGS. 6 and 7. *Surirella ovata* Bréb. var. *ovata* Kütz.
8 to 10. *Anomoeoneis polygramma* Ehrenb.
FIG. 11. *Scoliopleura pavlovi* sp. nov.
12. *Cymatopleura elliptica* Bréb.
FIGS. 13 and 14. *Surirella ovata* Bréb. var. *ovata* Kütz.
FIG. 15. *Nitzschia obtusa* Smith.

PLATE 2

FIG. 1. *Asterionella formosa* Hassal.
2. *Synedra limnetica* Lemm.
3. *Navicula gastrum* Ehrenb. forma.
4. *Anomoeoneis sphaerophora* Kütz.
5. *Navicula elsae thum* Pant.
6. *Navicula perrotettii* Grun.
7. *Amphora ovalis* Kütz. var. *pediculus* Kütz. forma *mongolica* forma nova.
8. *Tryblionella debilis* Arnott and Rylands.
9. *Tryblionella tryblionella* Hantzsch. var. *levidensis* W. Smith.
10. *Tryblionella acuminata* Smith.
11. *Surirella ovata* Bréb. var. *ovata* Kütz. forma *curta* forma nova.
12. *Tryblionella tryblionella* Hanzsch.
13. *Nitzschia rigida* Kütz.
14. *Surirella ovata* Bréb. var. *ovata* Kütz. forma *mongolica* forma nova.
15. *Surirella ovata* Bréb. var. *ovata* Kütz.

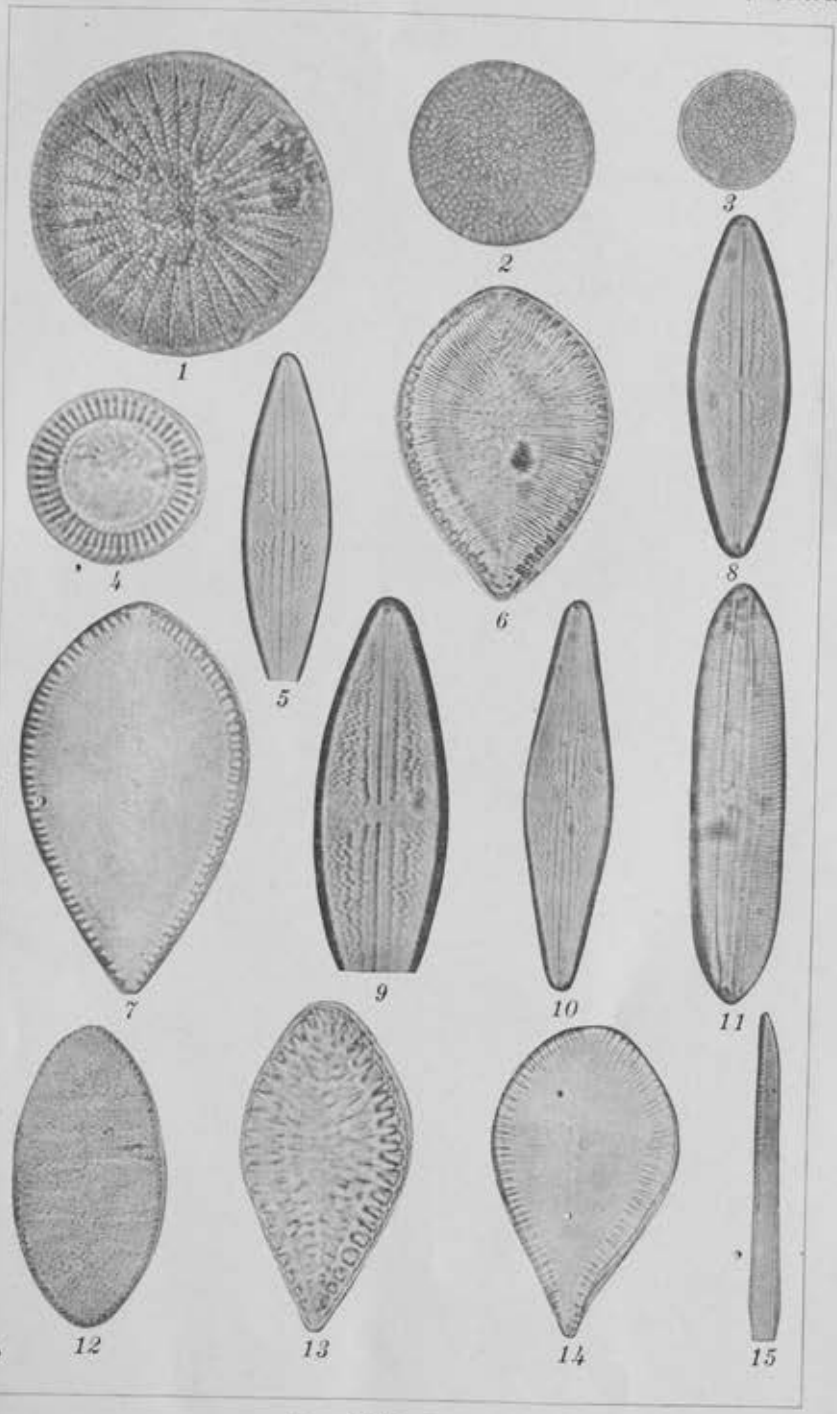

PLATE 1.

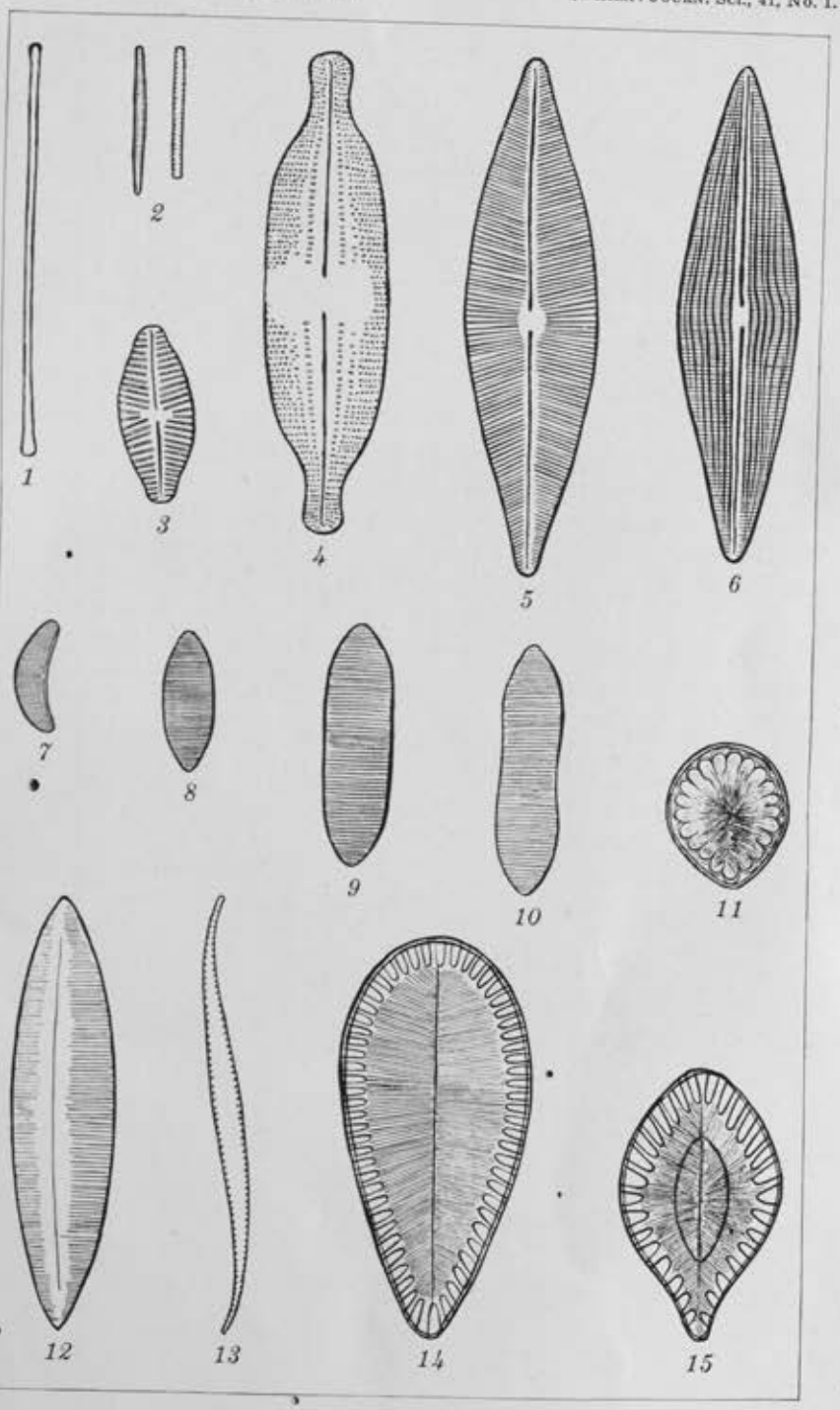

PLATE 2.

ALPINE DIATOMS FROM FUKIEN PROVINCE, SOUTH CHINA

By B. W. SKVORTZOW

Of Harbin, China

THREE PLATES

The diatoms included in this paper were collected by me at Kuliang, Fukien Province, in South China. This place is 9 kilometers from Foochow, and is 2,400 feet above sea level.

Among different gatherings of diatoms I found an alga collected in a mountain stream that was exceedingly rich in this alga and contained many interesting fresh- and brackish-water forms, some of which are subtropical and tropical origin and are known only from Asia, Japan, and Brazil.

The most interesting species was *Triceratium whampoense*, known from Whampoa (Canton, China), Java, and Sumatra, and fossil in Ungarn, Europe. *Eunotia clevei*, of Fukien, is found in large lakes in northern Europe; fossil and recent in Norway, Finland, and Japan; and recent in Baikal Lake, Siberia. The Chinese alga I describe herewith as *E. clevei* var. *sinica* var. nov. *Pinnularia montana* and *Eunotia tropica* were described by Fr. Hustedt from Japan, and *Amphipleura pellucida* var. *recta* was found by F. Kitton forty-five years ago in stomachs of Japanese oysters.

Very little attention has until recently been bestowed upon the diatoms of Fukien Province. They are listed in two of my notes.[1] The diatoms found in the Kuliang stream are as follows:

MELOSIRA ARENARIA Moore.

Diameter, 0.047 to 0.085 millimeter.

MELOSIRA UNDULATA Kütz. Plate 2, fig. 1.

Length, 0.076 millimeter; breadth, 0.057.

MELOSIRA VARIANS Agardh.

Diameter, 0.029 to 0.042 millimeter.

[1] Journ. North China Br. Roy. Asiatic Soc. (1919) and 53 (1922).

TRICERATIUM WHAMPOENSE Schwarz. Plate 1, figs. 1–6.

Hedwigia 11 (1874) 163; *Hydrosera triquetra* WALLICH, Micr. Journ. 6: 251, pl. 13, figs. 1–6; A. SCHMIDT, Atlas Diat. Hefte 20, pl. 78, figs. 36–38; *Triceratium javanicum* CLEVE, On some new and little-known diatoms (1881) 24, pl. 6, fig. 75; Diatomeentafeln zusammengestellt für einige Freunde, New York, pl. 17, figs. 6–7; *Hydrosera boreana* J. PANTOCSEK, Beitrage zur kenntnis der Fossilen Bacil. Ungarns. (1903) 83, pl. 30, fig. 428.

Valve plane, hexagonal, with three angles separated from the disc by transverse lines alternating with three other angles. Structure 5 to 7 gonal cells, 4 to 5 in 0.01 millimeter, absent from the ends of the three first-named angles. Diameter, 0.95 to 0.115 millimeter. Habitat: Fresh and brackish waters of Java, Sumatra, and Whampoa, South China; fossil in Ungarn.

SYNEDRA ULNA (Nitzsch.) Ehrenb.

Length, 0.187 millimeter; breadth, 0.01; striæ, 9 in 0.01 millimeter.

SYNEDRA ULNA var. SUBAEQUALIS Grun.

Length, 0.22 millimeter; breadth, 0.0068; striæ, 8.5 in 0.01 millimeter.

SYNEDRA GALLIONII Ehrenb.

Length, 0.34 millimeter; breadth, 0.0085; striæ, 9 in 0.01 millimeter. Habitat: Brackish and marine waters.

SYNEDRA PULCHELLA Kütz.

Length, 0.051 millimeter; breadth, 0.003; striæ, 15 in 0.01 millimeter.

EUNOTIA PECTINALIS Kütz.

Length, 0.102 millimeter; breadth, 0.008; striæ, 12 in 0.01 millimeter.

EUNOTIA MAYOR W. Smith var. ASIATICA var. nov. Plate 2, fig. 11.

Valvis elongatis, medio undulatis, ad polos capitatis, 0.111 mm longis 0.0068 mm latis. Striæ, 12 in 10 micron.

Habitat: Foochow and Hanka Lake, Primorsk Province of SSSR.

EUNOTIA TROPICA Hustedt. Plate 2, fig. 12.

Length, 0.782 to 0.102 millimeter; breadth, 0.013 to 0.014; striæ, 11 to 12 in 0.01 millimeter. Habitat: Japan.

EUNOTIA CLEVEI Grun. **var. SINICA var. nov.** Plate 2, figs. 2 and 3; Plate 3, fig. 8.

Valvis inflexis, 0.2 ad 0.22 mm longis, 0.03 ad 0.04 mm latis. Punctis 15 in 10 micron, ad polis rotundatis modice attenuatis.

Eunotia clevei is found in northern Europe (recent and fossil) and in Baikal Lake.

ACHNANTHES FUKIENSIS sp. nov. Plate 2, fig. 4.

Valvis lanceolatis, cum polis attenuatis et rotundatis, 0.037 ad 0.039 mm longis, 0.01 ad 0.011 mm latis. Striæ punctatæ, 9 in 10 micron. Valvæ inferiores ad nodulum centralem una stria abbreviata notata.

ACHNANTHES INFLATA Kütz.

Length, 0.051 to 0.085 millimeter; breadth, 0.014 to 0.017; striæ, 7.5 to 9 in 0.01 millimeter.

ACHNANTHES INFLATA var. SINICA var. nov. Plate 2, fig. 5.

Valvis elongatis, 0.124 ad 0.128 mm longis, 0.025 mm latis. Striæ, 6.5 in 10 micron.

ACHNANTHES BREVIPES Ag. var. INTERMEDIA Kütz. Plate 3, fig. 12.

Length, 0.047 to 0.076 millimeter; breadth, 0.013 to 0.02; striæ, 6.5 to 7 in 0.01 millimeter. Habitat: Brackish and marine waters.

ACHNANTHIDIUM LANCEOLATA Bréb.

Length, 0.017 millimeter; breadth, 0.0068; striæ, 12 in 0.01 millimeter.

ACHNANTHIDIUM LANCEOLATA var. DUBIA Grun.

Length, 0.025 millimeter; breadth, 0.0136; striæ, 9 in 0.01 millimeter.

COCCONEIS PLACENTULA Ehrenb. var. EUGLYPTA Ehrenb.

Length, 0.042 millimeter; breadth, 0.023; striæ, 27 in 0.01 millimeter.

MICRONEIS MINUTISSIMA Kütz.

Length, 0.012 millimeter; breadth, 0.0034.

CALONEIS SILICULA Ehrenb. var. GENUINA Cleve.

Length, 0.076 millimeter; breadth, 0.014; striæ, 18 in 0.01 millimeter.

NEIDIUM KOZLOWI Mereschkovski var. CEYLONICA var. nov. Plate 2, fig. 6.

Valvis lanceolatis cum polis productis et accuminatis, 0.064 mm longis, 0.0136 mm latis. Striæ 22 ad 25 in 10 micron.

Habitat: Foochow and Ceylon.

DIPLONEIS ELLIPTICA Kütz. Plate 3, fig. 10.

Length, 0.065 millimeter; breadth, 25.

DIPLONEIS ELLIPTICA Kütz. var. GROSSE-PUNCTATA Pant.

Length, 0.073 millimeter; breadth, 0.037; striæ, 7 in 0.01 millimeter.

DIPLONEIS FINNICA (Ehrenb.) Cleve forma SINICA forma nova. Plate 2, fig. 10.

Valvis minoribus, 0.032 mm longis, 0.02 mm latis. Striæ 10 in 10 micron.

Habitat: *Diploneis finnica* is found, fossil and recent, in Sweden, Finland, United States of America, and Canada.

NAVICULA FUKIENSIS sp. nov. Plate 2, fig. 7.

Valvis angustatis, attenuatis, arcuatis, 0.0306 ad 0.035 mm longis, 0.0085 mm latis. Striæ punctatæ subradiantes, 7 ad 8 in 10 micron, medio valvæ vitta transversa nuda interruptis. E grege *N. torneensis* Cleve var. *adoensis* Cleve.

NAVICULA BACILLUM Ehrenb.

Length, 0.037 to 0.051 millimeter; breadth, 0.01; striæ, 21 in 0.01 millimeter.

NAVICULA LAMBDA Cleve. Plate 2, fig. 8.

Length, 0.068 to 0.069 millimeter; breadth, 0.013 to 0.017; striæ, 14 to 15 in 0.01 millimeter.

NAVICULA LAMBDA var. RECTA var. nov. Plate 2, fig. 13.

Valvis ad marginem rectis ad polos rotundatis, 0.105 mm longis, 0.025 mm latis. Striæ 13 ad 14 in 10 micron.

NAVICULA DICEPHALA (Ehrenb.) W. Smith.

Length, 0.025 millimeter; breadth, 0.0085; striæ, 0.012 to 0.014 in 0.01 millimeter.

NAVICULA MUTICA Kütz.

Length, 0.022 millimeter; breadth, 0.0059.

NAVICULA GREGARIA Donk.

Length, 0.027 millimeter; breadth, 0.006 to 0.007; striæ, 0.009 in 0.01 millimeter. Habitat: Brackish water.

NAVICULA VIRIDULA Kütz. var. SLESVICENSIS Grun.

Length, 0.042 millimeter; breadth, 0.007; striæ, 9 to 10 in 0.01 millimeter. Habitat: Brackish water.

NAVICULA RADIOSA Kütz.

Length, 0.059 millimeter; breadth, 0.0085; striæ, 10 in 0.01 millimeter.

NAVICULA CHINENSIS sp. nov. Plate 3, fig. 11.

Valvis ellipticis incrassatis, ad polos attenuatis et rotundatis, 0.042 ad 0.043 mm longis, 0.018 ad 0.019 mm latis. Structura

punctata; punctis in strias transversas subradiantes ordinatis, 24 in 10 micron. E grege *N. glacialis* Cleve.

PINNULARIA MESOLEPTA Ehrenb. var. ANGUSTA Cleve forma SINICA forma nova. Plate 2, fig. 17.

Valvis 0.098 mm longis, 0.014 mm latis. Striæ 11 in 10 micron.

PINNULARIA STAUROPTERA (Grun.) Rabenh. var. INTERRUPTA Cleve.

Length, 0.097 millimeter; breadth, 0.012; striæ, 9 in 0.01 millimeter.

PINNULARIA LEGUMEN Ehrenb.

Length, 0.136 millimeter; breadth, 0.0187; striæ, 11 in 0.01 millimeter.

PINNULARIA MACILENTA (Ehrenb.) Cleve.

Length, 0.17 millimeter; breadth, 0.025; striæ, 7 in 0.01 millimeter.

PINNULARIA MONTANA Hustedt var. SINICA var. nov. Plate 2, fig. 14; Plate 3, fig. 13.

Valvis elongatis, concavis ad polos rotundatis, 0.127 ad 0.13 mm longis, 0.021 mm latis. Striæ 8 in 10 micron. Rhaphe directa, area axillaris et centralis dilatata.

Habitat: *Pinnularia montana* was described from Aokiko Lake, Japan.

PINNULARIA OBLONGA (Kütz.) W. Smith var. GENUINA Grun.

Length, 0.093 to 0.112 millimeter; breadth, 0.017 to 0.018; striæ, 11 to 12 in 0.01 millimeter.

PINNULARIA ACROSPHAERIA Bréb. forma GENUINA Cleve.

Length, 0.136 millimeter; breadth, 0.017; striæ, 12 in 0.01 millimeter.

PINNULARIA CHINENSIS sp. nov. Plate 2, fig. 9.

Valvis attenuatis, linearibus, cum polis rotundatis ad medio valvæ modice constrictis, 0.068 ad 0.07 mm longis; 0.009 mm latis. Striæ subradiantes, 9 ad 10 in 10 micron, medio valvæ vitta transversa nuda interruptis.

PINNULARIA MAJOR Kütz. Plate 3, fig. 14.

Length, 0.178 millimeter; breadth, 0.0306; striæ, 7 in 0.01 millimeter.

PINNULARIA MAJOR var. LINEARIS Cleve.

Length, 0.17 millimeter; breadth, 0.028; striæ, 6.5 in 0.01 millimeter.

STAURONEIS ANCEPS Ehrenb. var. BIROSTRIS Ehrenb.

Length, 0.095 millimeter; breadth, 0.015; striæ, 21 in 0.01 millimeter.

STAURONEIS ANCEPS var. AMPHICEPHALA Kütz.

Length, 0.087 millimeter; breadth, 0.02.

AMPHIPLEURA PELLUCIDA Kütz. var. RECTA Kitton. Plate 2, fig. 15.

Valve linear with gently cuneate ends, length, 0.187 to 0.25 millimeter; breadth, 0.018 to 0.022; striæ, 28 in 0.01 millimeter. This curious diatom was described by Kitton [2] from stomachs of Japanese oysters.

FRUSTULIA VULGARIS Thw. var. CONSTRICTA var. nov. Plate 2, fig. 18.

Valvis constrictis, 0.057 ad 0.059 mm longis, 0.007 ad 0.0075 mm latis.

FRUSTULIA VULGARIS var. ASIATICA Skv.

Length, 0.051 millimeter; breadth, 0.0085. Habitat: North Manchuria, Hingan Mountains.

FRUSTULIA RHOMBOIDES Ehrenb. var. SAXONICA Rabenh.

Length, 0.068 millimeter; breadth, 0.014.

FRUSTULIA RHOMBOIDES var. AMPHIPLEUROIDES Grun.

Length, 0.113 millimeter; breadth, 0.022; striæ, 16 to 17 in 0.01 millimeter.

GOMPHONEMA LANCEOLATUM Ehrenb.

Length, 0.042 millimeter; breadth, 0.013; striæ, 12 in 0.01 millimeter.

GOMPHONEMA BRASILIENSE Grun. Plate 2, fig. 19.

Length, 0.042 millimeter; breadth, 0.007; striæ, 14 in 0.01 millimeter. Habitat: Brazil, Cuba, and Bengal.

GOMPHONEMA PUIGGARIANUM Grun. var. SINICA var. nov. Plate 2, fig. 20.

Valvis lanceolatis cum polis productis, attenuatis, 0.04 ad 0.044 mm longis, 0.0068 ad 0.01 mm latis cum striis punctatis. validis abbreviatis, marginalibus, 13 ad 15 in 10 micron. Rhaphe directa, poro centralis absents.

Habitat: Typical *G. puiggarianum* is found in Brazil, Ecuador, and San Nicolas.

GOMPHONEMA CONSTRICTUM Ehrenb. var. CAPITATA Ehrenb.

Length, 0.059 millimeter; breadth, 0.013 to 0.014; striæ, 9 to 10 in 0.01 millimeter.

[2] Journ. Quekett Micros. Club, ser. 9 (1884) 18, pl. 4, fig. 4*a*.

GOMPHONEMA SPHAEROPHORUM Ehrenb. var. ASIATICA var. nov. Plate 2, fig. 16.

Valvis lanceolatis, polos productis, parte anteriore capitatis, 0.042 ad 0.061 mm longis, 0.001 ad 0.0012 mm latis. Striæ 10 ad 11 in 10 micron.

GOMPHONEMA PARVULUM Kütz.

Length, 0.025 to 0.028 millimeter; breadth, 0.012; striæ, 15 in 0.01 millimeter.

GOMPHONEMA SUBTILE Ehrenb.

Length, 0.061 millimeter; breadth, 0.012; striæ, 12 in 0.01 millimeter.

GOMPHONEMA SUBCLAVATUM Grun.

Length, 0.076 to 0.105 millimeter; breadth, 0.013 to 0.017; striæ, 7 to 8 in 0.01 millimeter.

CYMBELLA TUMIDA Bréb.

Length, 0.051 millimeter; breadth, 0.016; striæ, 13 in 0.01 millimeter.

CYMBELLA TUMIDA var. BOREALIS Grun.

Length, 0.074 to 0.085 millimeter; breadth, 0.018 to 0.02; striæ, 8 to 9 in 0.01 millimeter.

CYMBELLA NAVICULIFORMIS Auersw.

Length, 0.037 millimeter; breadth, 0.0085; striæ, 15 in 0.01 millimeter.

CYMBELLA GRACILIS Rabenh.

Length, 0.039 to 0.0527 millimeter; breadth, 0.008 to 0.01; striæ, 12 to 15 in 0.01 millimeter.

CYMBELLA VENTRICOSA (Kütz.) Cleve var. LAEVIS (Naegeli) A. Mayer.

Length, 0.02 millimeter; breadth, 0.0064; striæ, 14 in 0.01 millimeter.

CYMBELLA VENTRICOSA var. GENUINA A. Mayer forma MINUTA (Hilse) A. Mayer.

Length, 0.017 millimeter; breadth, 0.006; striæ, 15 in 0.01 millimeter.

CYMBELLA ASPERA Ehrenb.

Length, 0.141 to 0.187 millimeter; breadth, 0.034 to 0.042; striæ, 6 to 6.5 in 0.01 millimeter.

CYMBELLA ASPERA var. MANSHURICA Skv. Plate 3, figs. 5, 6, and 7.

Length, 0.289 millimeter; breadth, 0.0527; striæ, 6.5 in 0.01 millimeter. Habitat: North Manchuria, Hingan.

CYMBELLA SIGNATA Pant. var. CHINENSIS var. nov. Plate 2, fig. 21.

Valvis robustis, tumidis, polis productis, obtusis, 0.0527 mm longis, 0.013 mm latis. Striæ subradiantes, 8.5 in 10 micron.

AMPHORA OVALIS Kütz. var. GRACILIS (Ehrenb.) Van Heurck.

Length, 0.037 millimeter; breadth, 0.0136; striæ, 17 in 0.01 millimeter.

AMPHORA OVALIS var. TYPICA Cleve.

Length, 0.0442 millimeter; breadth, 0.0238; striæ, 14 in 0.01 millimeter.

EPITHEMIA ZEBRA (Ehrenb.) Kütz. var. SAXONICA Kütz.

Length, 0.044 to 0.059 millimeter; breadth, 0.01.

EPITHEMIA HYNDMANNII W. Smith.

Length, 0.132 millimeter; breadth, 0.021.

EPITHEMIA HYNDMANNII var. CHINENSIS var. nov. Plate 2, figs. 22 and 23; Plate 3, fig. 9.

Valvis curvatis cum polis productis et rotundatis, 0.44 ad 0.096 mm longis, 0.01 ad 0.0136 mm latis. Striæ 2 ad 4 in 10 micron, puncta 11 ad 12 in 10 micron.

RHOPALODIA GIBBA (Ehrenb.) O. Müll.

Length, 0.124 millimeter; breadth, 0.022.

RHOPALODIA VENTRICOSA (Grun.) O. Müll.

Length, 0.072 millimeter; breadth, 0.01.

NITZSCHIA CLAUSII Hantzsch.

Length, 0.056 to 0.058 millimeter; breadth, 0.005 to 0.007; striæ, 9 to 10 in 0.01 millimeter.

NITZSCHIA COMMUNIS Rabenh.

Length, 0.032 to 0.037 millimeter; breadth, 0.034 to 0.0052; striæ, 12 to 15 in 0.01 millimeter.

HANTZSCHIA AMPHIOXYS (Kütz.) Grun. var. XEROPHILA Grun.

Length, 0.039 millimeter; breadth, 0.0059.

HANTZSCHIA AMPHIOXYS var. ELONGATA Grun.

Length, 0.22 millimeter; breadth, 0.014; kiel puncta, 6 in 0.01 millimeter; striæ, 18 to 20 in 0.01 millimeter.

SURIRELLA SPLENDIDA (Ehrenb.) Kütz.

Length, 0.147 millimeter; breadth, 0.042; costæ, 3 in 0.01 millimeter.

SURIRELLA SPLENDIDA var. ELONGATA A. Mayer.

Length, 0.137 millimeter; breadth, 0.027; costæ, 2 in 0.01 millimeter.

SURIRELLA SPIRALIS Kütz. Plate 3, fig. 4.

Length, 0.153 millimeter; breadth, 0.05; costæ, 2 in 0.01 millimeter.

SURIRELLA ENGLERI O. Müll. forma SUBCONSTRICTA O. Müll.?

Length, 0.192 millimeter; breadth, 0.034; costæ, 5 in 0.01 millimeter. Habitat: Nyassa Lake, Africa.

SURIRELLA FUKIENSIS sp. nov. Plate 2, fig. 25; Plate 3, fig. 1.

Valvis elongatis, 0.333 mm longis, 0.055 mm latis, ad polos attenuatis et rotundatis, costis marginalibus, validis, accuato-confluentibus, 3 ad 4 in 10 micron, usque ad pseudorhaphem distinctam percurrentibus.

SURIRELLA SAXONICA Auersw. Plate 3, fig. 2.

Length, 0.144 to 0.245 millimeter; breadth, 0.062 to 0.08; costæ, 2 to 3 in 0.01 millimeter.

SURIRELLA SAXONICA var. SINICA var. nov. Plate 2, fig. 24.

Valvis elongato-ovalis, 0.111 mm longis, 0.03 mm latis. Costæ 3 in 10 micron ad pseudorhaphem punctatis.

SURIRELLA ARCTA A. Smith.

Length, 0.252 millimeter; breadth, 0.034; costæ, 3 in 0.01 millimeter.

SURIRELLA CAPRONII Bréb. Plate 3, fig. 3.

Length, 0.235 millimeter; breadth, 0.032.

ILLUSTRATIONS

PLATE 1

FIGS. 1 to 6. *Triceratium whampoense* Schwarz.

PLATE 2

FIG. 1. *Melosira undulata* Kütz.
FIGS. 2 and 3. *Eunotia clevei* Grun. var. *sinica* var. nov.
FIG. 4. *Achnanthes fukiensis* sp. nov.
5. *Achnanthes inflata* Kütz var. *sinica* var. nov.
6. *Neidium kozlowi* Mer. var. *ceylonica* var. nov.
7. *Navicula fukiensis* sp. nov.
8. *Navicula lambda* Cleve.
9. *Pinnularia chinensis* sp. nov.
10. *Diploneis finnica* (Ehrenb.) Cleve forma *sinica* forma nova.
11. *Eunotia major* W. Smith var. *asiatica* var. nov.
12. *Eunotia tropica* Hustedt.
13. *Navicula lambda* Cleve var. *recta* var. nov.
14. *Pinnularia montana* Hustedt var. *sinica* var. nov.
15. *Amphipleura pellucida* Kütz. var. *recta* Kitton.
16. *Gomphonema sphaerophorum* Ehrenb. var. *asiatica* var. nov.
17. *Pinnularia mesolepta* Ehrenb. var. *angusta* Cleve forma *sinica* forma nova.
18. *Frustulia vulgaris* Thw. var. *constricta* var. nov.
19. *Gomphonema brasiliese* Grun.
20. *Gomphonema puiggarianum* Grun. var. *sinica* var. nov.
21. *Cymbella signata* Pant. var. *chinensis* var. nov.

FIGS. 22 and 23. *Epithemia hyndmannii* W. Smith var. *chinensis* var. nov.
FIG. 24. *Surirella saxonica* Auersw. var. *sinica* var. nov.
25. *Surirella fukiensis* sp. nov.

PLATE 3

FIG. 1. *Surirella fukiensis* sp. nov.
2. *Surirella saxonica* Auersw.
3. *Surirella capronni* Bréb.
4. *Surirella spiralis* Kütz.

FIGS. 5, 6, and 7. *Cymbella aspera* Ehrenb. var. *manshurica* Skv.
FIG. 8. *Eunotia clevei* Grun. var. *sinica* var. nov.
9. *Epithemia hyndmannii* W. Smith var. *chinensis* var. nov.
10. *Diploneis elliptica* Kütz.
11. *Navicula chinensis* sp. nov.
12. *Achnanthes brevipes* Ag. var. *intermedia* Kütz.
13. *Pinnularia montana* Hustedt var. *sinica* var. nov.
14. *Pinnularia major* Kütz.

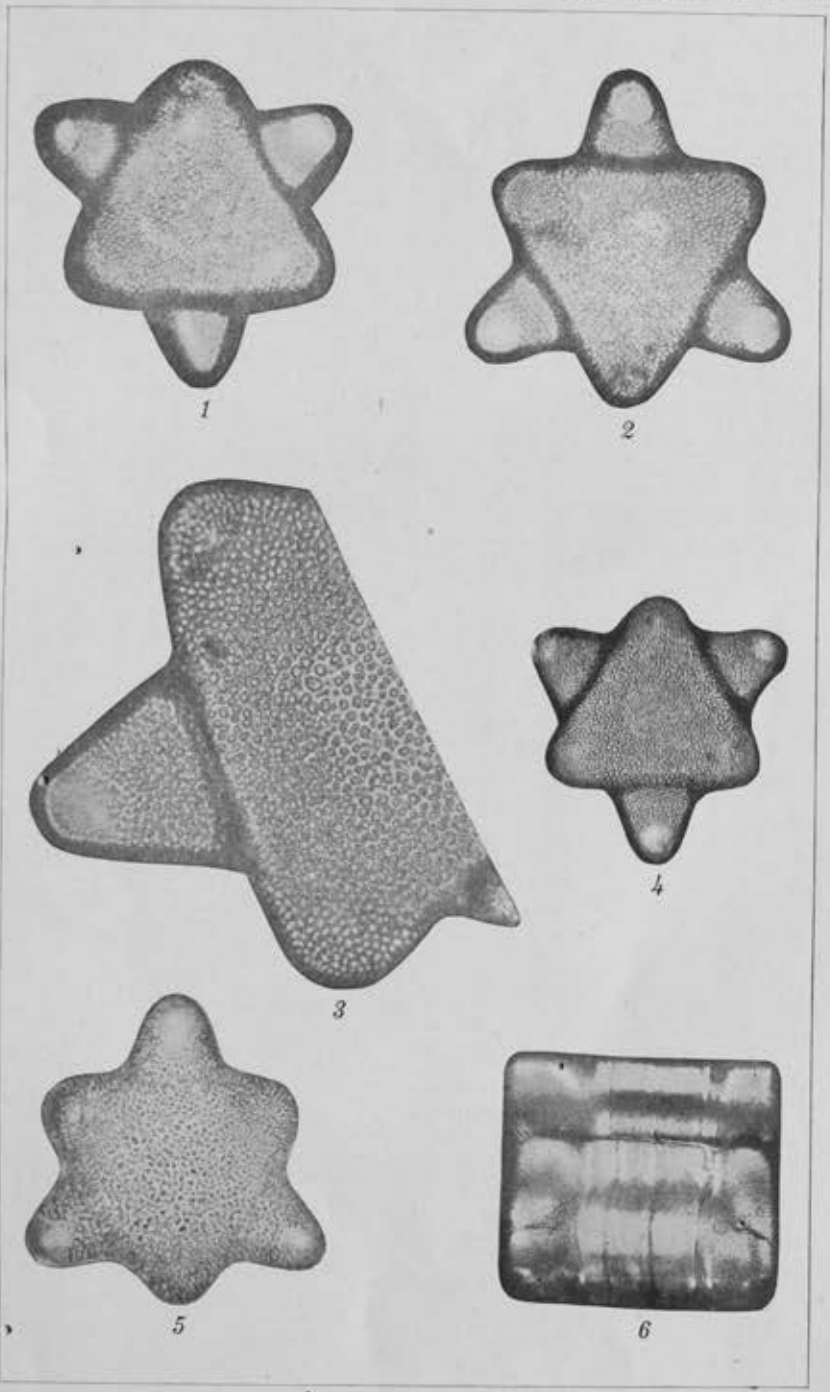

PLATE 1.

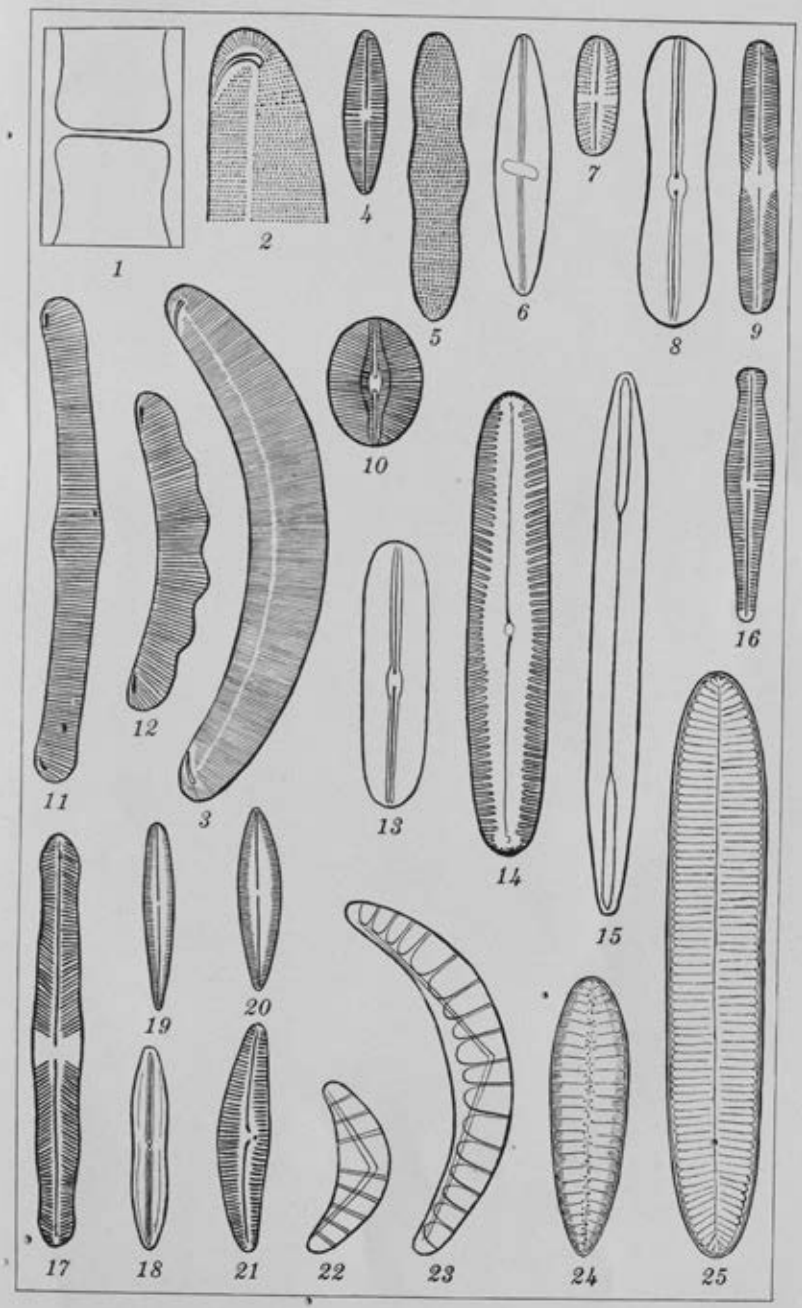

PLATE 2.

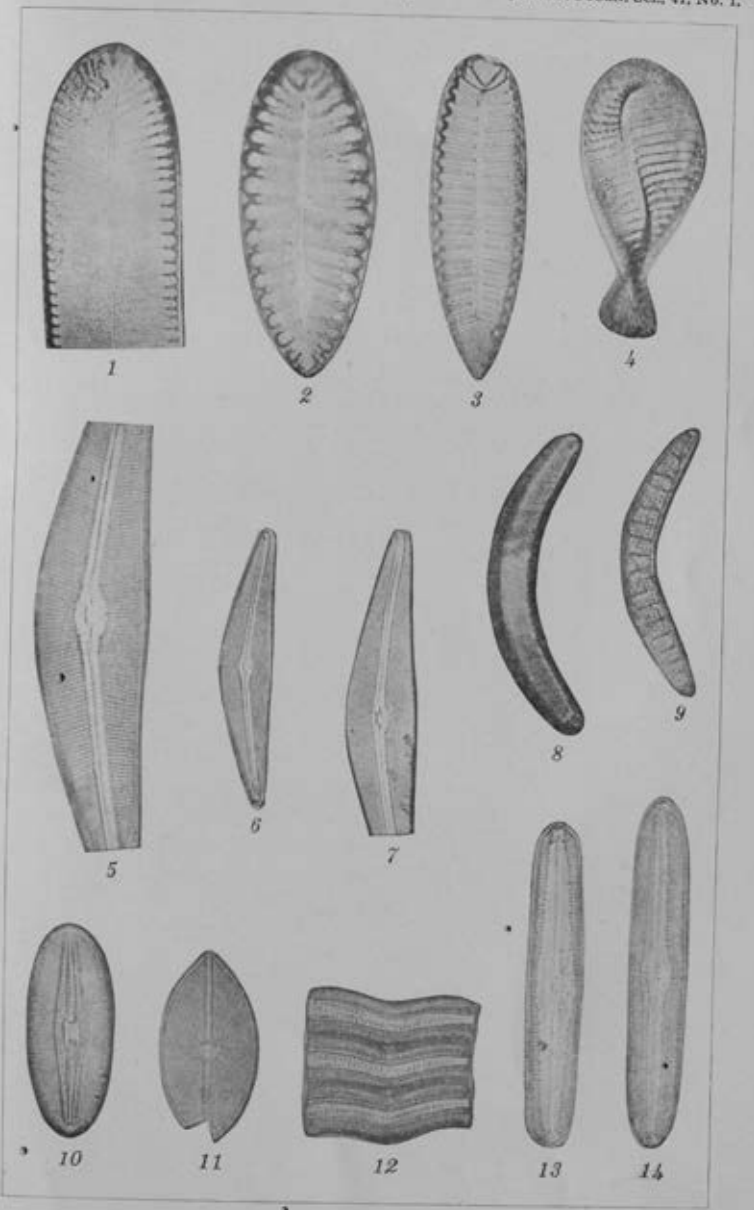

PLATE 3.

WATER-WHITE COCONUT OIL AND COCONUT FLOUR

By AURELIO O. CRUZ and AUGUSTUS P. WEST
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Coconut oil is employed considerably in making edible fats and artificial butter.

The quantity and value of coconut oil, copra, copra cake, and desiccated coconut exported from the Philippines in 1927 is given in Table 1.[1] As shown by the total value, these coconut products represent one of the largest exports of the Philippines.

TABLE 1.—*Quantity and value of coconut oil, copra, copra cake, and desiccated coconut exported from the Philippines in 1927.*

	Quantity exported.	Value.
	kg.	*Pesos.*[a]
Coconut oil	144,802,683	49,681,366
Copra	199,318,985	38,311,481
Copra cake	90,761,976	4,969,078
Desiccated coconut	15,183,651	5,700,120
Total		98,662,045

[a] One Philippine peso equals 50 cents United States currency.

The usual method of obtaining coconut oil is essentially as follows:

The husks are first removed from the nuts, after which they are split by a large knife and the milk poured off. The split nuts are next dried in the sun, or by artificial heat, after which the dried meat, or copra, is easily removed from the shells. The copra is then ground in a mill, heated, and subjected to pressure. The oil which is thus obtained from the expeller has a yellow color. The oil cake which remains after the first expression contains usually about 12 per cent of oil. This cake is subjected to a second expression by means of hydraulic presses after which it contains only about 5 per cent of oil. The coconut oil obtained is filtered and stored in large tanks, ready

[1] Annual Report, Insular Collector of Customs, Manila, 1928.
[2] West, A. P., and W. H. Brown, Philip. Bur. Forestry, Bull. 20 (1920) 91.

for domestic use or export. The brown oil cake, which remains after the oil has been expressed, is usually used as cattle food.

The quality and value of coconut oil depend largely upon the condition of the copra at the time of milling. Copra which has not been dried sufficiently becomes moldy. The molds tend to decompose, or hydrolyze, the fats in the copra, with the result that the oil, after expression, contains free fatty acids, becomes rancid quickly, and acquires a dark yellow color and bad odor. If the copra is dried thoroughly until it contains no more than 5 per cent of moisture, the growth of molds and the formation of free fatty acids is prevented.[3] In preparing high-grade coconut oil only ripe nuts should be used and the copra should be fresh and dried thoroughly. The oil should be expressed from the copra as soon as possible, thereby avoiding long storage in a warm, moist atmosphere. The fresh coconut oil should be dry and filtered until absolutely free of vegetable matter. The presence of vegetable matter in the oil is likely to attract molds which enter the oil and cause a rapid splitting of the fat and increase in acidity.

In the Philippines coconut oil is usually made from copra which has not been dried sufficiently. The oil contains usually free fatty acids which increase in amount when the oil is stored. As a result the oil must be refined before it is suitable for the manufacture of edible products. This requires an additional expense which would not be necessary if the oil were made from thoroughly dried copra. High-grade coconut oil brings a better price than medium grades, and it would be very beneficial to the local trade in general if the quality of Philippine copra were improved.

In the preparation of shredded coconut the shell is split by a large knife and removed from the coconut kernels. As the kernels are covered with a dark skin, or seed coat (tegmen), this brown seed coat (coconut parings) is very carefully removed in thin sections from the kernels by paring with a knife. The white kernels are then washed, cut into pieces, and passed through a shredding machine which cuts the meat into thin pieces resembling strings. These strings are then dried by passing through an oven, and packed for export.

Coconut oil prepared in the usual manner from kernels containing the dark seed coat has a yellow color. Oil prepared

[3] Walker, H. S., Philip. Journ. Sci. 1 (1906) 71; 140; 3 § A (1908) 106. Brill, H. C., H. O. Parker, and H. S. Yates, Philip. Journ. Sci. 12 § A (1917) 55.

from white shredded coconut, which contains no seed coat, usually has a rather water-white appearance when clarified. The oil cake which remains after expressing the oil from shredded coconut has a very white and clean appearance.

Coconut oil is characterized by having a low iodine number which ranges from about 8 to 9.5. Some years ago Richardson [4] pointed out the fact that oil obtained from the brown seed coats of the coconut kernels had a much higher iodine number than ordinary commercial coconut oil. Subsequently Allan and Moore [5] obtained coconuts from different countries and removed the brown seed coats from the coconut kernels. They then tested the oil obtained from the white coconut meat and also from the brown seed coats and found that the iodine number of the white-meat oil was somewhat less then the iodine number of ordinary commercial oil while the iodine number of the seed-coat oil was considerably higher.

We thought it might, perhaps, be interesting to get some additional data on this water-white coconut oil prepared from Philippine kernels from which the brown seed coat was removed (shredded coconut) and also to investigate the white oil cake obtained from shredded coconut and the yellow oil made from the coconut seed coats (commercial parings of the coconut kernels) which are obtained as a by-product in the preparation of shredded coconut.

EXPERIMENTAL PROCEDURE

Water-white coconut oil.—This was prepared by expelling (cold pressing) oil from shredded coconut which was obtained from one of the Philippine companies. The oil was filtered through glass wool, to eliminate most of the fiber. The oil was then treated with about 2 per cent of dry Kieselguhr, shaken, and filtered. This treatment removes most of the moisture and colloidal vegetable matter contained in the oil. According to our experiments, there was still a very appreciable amount of dissolved colloidal matter contained in the oil after the treatment with Kieselguhr. In order to remove the remaining portion of dissolved colloidal matter, the oil was treated with about 2 per cent of vegetable charcoal (suchar), heated for a few minutes to a temperature of about 80° C., and filtered through filter paper. As the suchar was powdered very finely a small amount of it

[4] Journ. In. Eng. Chem. 3 (1911) 574.
[5] Journ. Soc. Chem. Ind. Trans. 44 (1925) 62.

passed through the filter. When the oil was treated with talcum powder and filtered again, the suchar was removed. By this treatment practically all of the colloidal matter was eliminated. When coconut oil is treated in this manner and allowed to stand for some months no sediment settles out in the oil. Coconut oil shaken with Kieselguhr and filtered has a very clear appearance which would seem to indicate that the oil is entirely free of solid particles. However, when the oil is allowed to stand for some days, a sediment precipitates out in the oil. When this sediment is removed by filtering and the oil again allowed to stand for some days another slight precipitation of sediment occurs. The sediment appears to be derived from dissolved colloidal matter which is not entirely removed by treatment with Kieselguhr and filtering.

Commercial-parings oil.—In preparing shredded coconut, the brown seed coats are sliced off the coconut kernels. These commercial coconut parings, which are obtained as a by-product in the manufacture of shredded coconut, were used for making the yellow oil of the coconut-kernel seed coat. This yellow oil was really obtained from a mixture of seed coats and white coconut meat since it is rather difficult commercially to remove the seed coat from the coconut kernels without cutting off some of the white coconut meat.

The constants of the oil obtained from the white coconut meat (shredded coconut) and also of the yellow oil made from the commercial parings are given in Table 2.

TABLE 2.—*Constants of water-white coconut oil made from white coconut meat (shredded coconut) and yellow oil made from commercial parings.*

Constants.	Oil from white meat.	Oil from parings.
Specific gravity $\frac{30° C.}{4° C.}$	0.9150	0.9124
Saponification value	261.4	243.7
Iodine value	5.4	19.7
Free fatty acids (as oleic)....per cent	0.05	0.77
Unsaponifiable matter....do	0.15	0.29
Refractive index at 30° C	1.4522	1.4550
Moisture and other volatile matter....per cent	0.03	
Color:[a]		
Red	0.05	0.9
Yellow	0.30	6.0

[a] The color was determined by a Wesson model, cabinet type colorimeter made by the Emil Greiner Co.

As shown by the data the water-white oil gave a much higher specific gravity and saponification value than the parings oil. The water-white oil gave an iodine value somewhat lower than ordinary commercial oil, while the parings oil gave a much higher value. The parings oil gave a much greater color than the water-white oil and also had a higher refractive index. The moisture content of the water-white oil was only 0.03 per cent and the unsaponifiable matter and free fatty acid content were also very low thus showing that this was an exceptionally high-grade oil.

The specific gravity of the water-white coconut oil and of ordinary high-grade commercial oil was determined for different degrees of temperature by the pycnometer method. As shown by the data (Table 3) the water-white oil has a higher specific gravity than the commercial oil.

TABLE 3.—*Specific gravity of water-white coconut oil and high-grade commercial coconut oil.*

Temperature.	Specific gravity compared to water at 4° C.	
	Water-white oil.	High-grade commercial oil.
°C.		
30	0.9150	0.9144
35	0.9114	0.9108
40	0.9079	0.9071
45	0.9043	0.9035

From the data given in Table 3 the specific gravity of the water-white oil was calculated for various degrees of temperature ranging from 26 to 49° C. The calculated figures are given in Table 4. Similar calculated specific gravities for both centigrade and Fahrenheit degrees are given in Table 5. As shown by the data given in these tables the specific gravity of this water-white coconut oil decreases uniformly with rise in temperature. As the specific gravity is a very important determination in the testing of commercial coconut oils, the calculated specific gravities of this very pure, water-white oil serve as a standard of comparison in estimating the quality of ordinary commercial oils.

Coconut flour.—The white oil cake obtained by expelling the oil from shredded coconut was disintegrated and dried in an

TABLE 4.—*Specific gravity of water-white coconut oil at different degrees of temperature, centigrade, compared to water as 4° C.*

Temperature.	Specific gravity.	Temperature.	Specific gravity.
°C.		°C.	
26	0.9179	38	0.9093
27	0.9172	39	0.9086
28	0.9165	40	0.9079
29	0.9157	41	0.9071
30	0.9150	42	0.9064
31	0.9143	43	0.9057
32	0.9136	44	0.9050
33	0.9129	45	0.9043
34	0.9122	46	0.9035
35	0.9114	47	0.9028
36	0.9107	48	0.9021
37	0.9100	49	0.9014

TABLE 5.—*Specific gravity of water-white coconut oil at different degrees of temperature, Fahrenheit and centigrade, compared to water at 4° C.*[a]

Temperature.		Specific gravity.	Temperature.		Specific gravity.	Temperature.		Specific gravity.
°F.	°C.		°F.	°C.		°F.	°C.	
77	25.00	0.9186	92	33.33	0.9126	107	41.66	0.9067
78	25.55	0.9182	93	33.88	0.9122	108	42.22	0.9063
79	26.11	0.9178	94	34.44	0.9118	109	42.77	0.9059
80	26.66	0.9174	95	35.00	0.9114	110	43.33	0.9055
81	27.22	0.9170	96	35.55	0.9110	111	43.88	0.9051
82	27.77	0.9166	97	36.11	0.9106	112	44.44	0.9047
83	28.33	0.9162	98	36.67	0.9102	113	45.00	0.9043
84	28.88	0.9158	99	37.22	0.9098	114	45.55	0.9039
85	29.44	0.9154	100	37.77	0.9094	115	46.11	0.9035
86	30.00	0.9150	101	38.33	0.9091	116	46.66	0.9031
87	30.55	0.9146	102	38.88	0.9087	117	47.22	0.9027
88	31.11	0.9142	103	39.44	0.9083	118	47.77	0.9023
89	31.66	0.9138	104	40.00	0.9079	119	48.33	0.9019
90	32.22	0.9134	105	40.55	0.9075	120	48.88	0.9015
91	32.77	0.9130	106	41.11	0.9071	121	49.44	0.9011

[a] Rise of 1° C. gives a decrease in specific gravity of 0.000717.
Rise of 1° F. gives a decrease in specific gravity of 0.000398.

oven at a temperature of 100° C. for about a half hour. This crisp, dried cake was passed through a grinder and converted into a rather coarse powder. This powder was then extracted with ether and allowed to dry on layers of filter paper, after which it was dried in an oven at 100° C. for about half an hour. This dried powder was then further ground and sieved until

about 97 per cent of the material passed a 20-mesh sieve. This white powdered oil cake thus prepared from shredded coconut was used as a flour in making coconut cookies which were found to be very tasty. Very good cakes were also obtained by mixing this coconut flour with ordinary wheat flour in various proportions.

Analysis of the coconut flour is given in Table 6. As shown by the figures the flour contains about 20 per cent of protein, a much higher proportion than is contained in wheat flour, which has about 12 per cent. This sample of coconut flour gave an ether extract of 7.18 per cent. By proper extraction methods this figure could be reduced considerably, especially if the flour were passed through rolling mills and ground very fine before extraction. It is not desirable to have much oil in the flour as the oil is likely to become rancid on standing and thus impart an undesirable odor to the flour.

As this coconut flour makes excellent cakes and is very suitable for human consumption, it is naturally more valuable than ordinary copra cake which is merely used as cattle food.

Analysis of the coconut parings (Table 6) shows that they were very rich in oil, containing nearly as much as commercial copra.

TABLE 6.—*Analysis of commercial coconut parings and coconut flour.*

	Coconut flour.	Coconut parings.
	Per cent.	*Per cent.*
Moisture	5.69	1.19
Ether extract	7.18	60.22
Crude fiber	9.21	4.60
Protein (N × 6.25)	20.39	9.51
Ash	5.41	2.26

SUMMARY

By cold pressing shredded coconut a water-white coconut oil is obtained. This oil has a high specific gravity and saponification value. The iodine value, free fatty acids, unsaponifiable matter, refractive index, moisture, and color are very low. As shown by the constants this water-white oil is an exceptionally high-grade coconut oil.

Oil from coconut parings gave a much higher iodine value than ordinary commercial coconut oil while the water-white oil gave a lower value.

The specific gravity of the water-white oil was determined at four different temperatures; namely, 30, 35, 40, and 45° C. From these results the specific gravity was calculated for various degrees of temperature ranging from 26 to 49° C. and from 77 to 121° F. As shown by the data the specific gravity decreases uniformly with rise in temperature. The calculated specific gravities of this very pure, water-white oil serve as a standard for estimating the quality of ordinary commercial oils.

By expelling the oil from shredded coconut a very white and clean oil cake is obtained. When powdered and extracted with a suitable solvent this oil cake may be used as a flour in making coconut cakes. This coconut flour contains about 20 per cent of protein which is a somewhat larger proportion than is usually contained in wheat flour. As this flour is edible it is naturally more valuable than ordinary copra cake which is merely used as cattle food.

PREFERENTIAL BREEDING CONDITIONS OF ANOPHELES IN THE PHILIPPINE ISLANDS

By J. J. MIELDAZIS
Of the Philippine Health Service, Manila

SIX PLATES

In making collections of anophelene mosquito larvæ in the Philippine Islands, one may be guided in the identification of some of the species by the character of the breeding places from which the larvæ were collected. Some species show a decided preference for a particular type of breeding place and will be found only under those conditions. The amount of shade seems to determine the presence of *Anopheles minimus* or *A. maculatus*. *Anopheles ludlowi* and *A. rossii* (both *A. vagus*, pool type, and *A. subpictus*, river type) are associated with sunlight. The presence of algæ or surface vegetation also seems to determine the presence of certain species.

As a general observation the breeding conditions favorable for the various Philippine anopheles are as follows:

Anopheles minimus may be called a bamboo species for it is always most prevalent when associated with bamboo, either in the mat of roots or clinging to dead bamboo leaves or twigs floating on the water surface. The particular breeding habits of this species present a unique problem. So far, it has not been found in any but flowing water. Its favorite breeding place is a flowing stream heavily shaded by bamboo. The larvæ prefer the roots of a clump of bamboo, where the stream undermines the bank of the stream and the interstices of the roots form an ideal protection against natural enemies. They have been found clinging to stones in heavily shaded stream beds. They have not been found in masses of algæ along the edges of rivers exposed to sunlight and within a few meters of numerous larvæ breeding in the shade of bamboo. An abrupt change of breeding has been noticed where a small section of a stream had been damned for a fish trap. *Anopheles minimus* larvæ were found in great numbers in the small shaded stream leading to this open fishpond covered with surface vegetation, and again, below the pond where the stream bed narrowed to

streamlike proportions. *Anopheles philippinensis, A. barbirostris, A. rossii,* and *A. hyrcanus* were found breeding in the fishpond.

Anopheles minimus has not been found in lowlands bordering on the sea, where the streams are affected by tide action. It is most generally found at the intersection of the coastal plain with the slope of a mountain range, and has been responsible for malaria in a valley 1,200 feet above sea level. More *A. minimus* have been found breeding in small streams shortly after a rain than during the last stages of evaporation, when the stream bed is a series of stagnant pools covered with surface vegetation.

Anopheles maculatus may be termed a sunshine substitute for *A. minimus.* This species prefers the clear flowing waters of mountain streams exposed to sunlight. It particularly prefers mats of grass roots or collections of algæ growing along the feathery edges of streams or rivers. It has been found breeding in large numbers in an isolated pool in a partially dried stream bed (Marveilles). Here it was associated with *A. barbirostris* and *A. vagus* (pool-type *rossii*). While prefering sun-exposed edges of streams, it is also found breeding in partially shaded sections of mountain streams. It is sometimes found breeding in the sun-exposed feathery edges of a stream, while *A. minimus* may be found in the shade on the opposite side of the stream.

It has been found breeding in a slight flow of seepage collected in a small sun-exposed ditch along a mountain road 2,000 feet above sea level in which the water surface was almost covered by dead leaves. It also has been found in grass-grown sun-exposed ditches of clear seepage water at 3,500 feet above sea level.

Anopheles philippinensis is closely associated with the growth of quiapo, *Pistia stratiotes,* in the Philippine Islands. This species has been found breeding most prolificly in the presence of this aquatic growth. It seems to flourish in pools of fresh rain water covered with this plant. As the water becomes contaminated by decayed vegetation, *A. philippinensis* is displaced by other species, especially *A. vagus* (pool-type *rossii*).

It has been found in rivers and streams after quiapo had started growing along the edges, and in rice fields where collections of this growth have been washed in by the flow from irrigation canals. It seems to be closely associated with the foothills of mountain ranges, where conditions are most favorable for the growth of quiapo in flowing water.

Anopheles ludlowi resembles *A. vagus* and *A. subpictus* and is usually found breeding with *A. subpictus*. It is associated with large rivers flowing in wide sand and gravel stream beds along the coastal plain. It is found along the feathery edges of rivers, along the edges of sand banks, or where the river is confined to a shallow channel in the sand river bottom, where the sun-exposed edges favor the growth of algæ.

It has been found in fishpond brackish water, where countless larvæ may be seen along the water surface carefully protected from natural enemies by the growth of aquatic vegetation which comes to the surface, leaving only a thin film of water for the production of anopheles larvæ.

It also has been found in shallow drinking holes dug in the sand river bottom close enough to the edge of the river for the infiltration of water. These holes are usually free of vegetation and algæ, but the larvæ may be found in great numbers.

It has been found in supersaturated collections of salt water in the last stages of evaporation in salt-evaporation beds.

Anopheles subpictus (river-type *rossii*) is always closely associated with *A. ludlowi*, but is more widely distributed than *A. ludlowi*. It has been found in growths of algæ along the sun-exposed edges of large coastal-plain rivers, and in salt-evaporation beds. It is usually not found in the evaporation beds above a 10 per cent concentration.

It is found in fishponds associated with *A. ludlowi*.

Anopheles vagus (pool-type *rossii*) is the most widely distributed Philippine anopheline. The larvæ have been collected with the larvæ of most of the other species of anopheles, except *A. ludlowi* and *A. subpictus*. It has been found in highly contaminated carabao wallow pools of warm water with clear mud sides and no vegetation. It has been found in muddy water in hoof prints near large collections of water or in seepage areas, in grass growing along the flowing or still waters of irrigation canals, in rice paddies after the water had been in the paddy long enough to become contaminated by growing rice, in contaminated water in isolated pools in stream and river beds, in collections of duckweed (*Lemna*) in stagnant pools in ditches along roads, and in the mouths of rivers within the limits of tide action. In general, it is found in waters contaminated beyond the breeding limits of other anophelines.

Anopheles barbirostris has been collected from still water in pools and also in swiftly flowing waters of streams and rivers. It is usually found in algæ, *Lemna*, or *Chara* growing along the

edges of streams. It has been found in collections of drift wood in the middle of the streams and in decayed wood embedded along the banks of streams. It may be found in rice fields in collections of *Lemna* or quiapo or in grass growing along the edges of irrigation canals. It also may be found in the deep sections of mountain streams or in the sun-exposed feathery edges of rivers in the costal plain.

Anopheles fuliginosus has been found in rain-water ponds with *A. philippinensis*, and in flowing streams and rivers. It also has been found in large collections of water impounded for irrigation purposes and in large sloughs.

Anopheles kochi breeds principally in rain-water pools without surface vegetation and with clean mud banks. It also has been found in rice fields in Laguna Province.

Very few larvæ of *Anopheles tesselatus* were collected. A few were reported collected from grass growing along the edges of irrigation canals. It is believed that it breeds in seepage areas in large collections of cogon grass. Numerous adults were caught at Novaliches at the time the streams were flooded and unsuitable for breeding purposes, but many seepage areas existed in the cogon grass.

Numerous larvæ of *Anopheles umbrosus* were found along the rib of a dead palm leaf floating on the surface of a heavily shaded stream. No specimens were collected from any other portion of this stream which was breeding *A. minimus*. No specimens have been reported from any portion of the Philippines except Mindanao.

ILLUSTRATIONS

PLATE 1

FIG. 1. Breeding place of *Anopheles minimus* in surface débris and in bamboo roots along the edge of Maitim River, Laguna.

2. Breeding place of *Anopheles minimus* along shaded edges of a small stream near Dupax, Nueva Vizcaya.

PLATE 2

FIG. 1. Breeding place of *Anopheles minimus* along small cane stalks growing along the edge of Gumain River, Pampanga.

2. Breeding place of *Anopheles minimus* on roots along edges of a stream. Breeding place of *Anopheles umbrosus* along the rib of a palm leaf floating on the portion of stream shown at the bottom of the picture, Zamboanga, Mindanao.

PLATE 3

FIG. 1. Breeding place of *Anopheles maculatus* along the sun-exposed edges of a mountain stream in Nueva Ecija.

2. Breeding place of *Anopheles philippinensis* in heavy quiapo growth on the surface of a rain-water pool, Balintawac, Rizal.

PLATE 4

FIG. 1. Breeding place of *Anopheles maculatus* along débris in small, roadside, seepage ditch between San Jose and Balete Pass, Nueva Ecija.

2. *Anopheles barbirostris* replaces *A. minimus* in a typical *minimus* stream when the stream flow is decreased and algæ grow along the water surface. Novaliches, Rizal.

PLATE 5

FIG. 1. Breeding place of *Anopheles ludlowi* in algæ growing along the sun-exposed feathery edges of Gumain River, Pampanga.

2. Breeding place of *Anopheles subpictus* (river-type *rossii*) in heavy growth of algæ on surface of water, Calauman River, Pampanga.

PLATE 6

FIG. 1. Breeding place of *Anopheles vagus* (pool-type *rossii*) in contaminated stagnant water in a stream bed, San Jose, Pampanga.

2. Breeding place of *Anopheles hyrcanus* in seepage in a low grass-grown area, Del Carmen, Pampanga.

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PLATE 1.

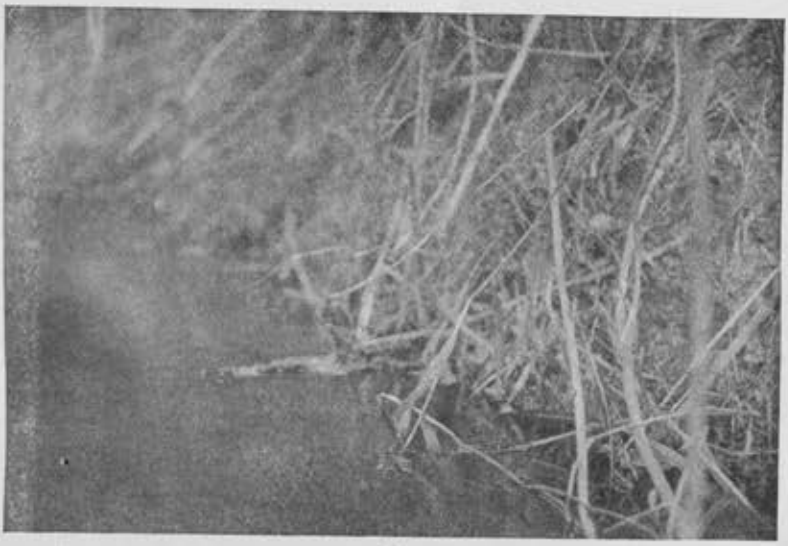

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PLATE 2.

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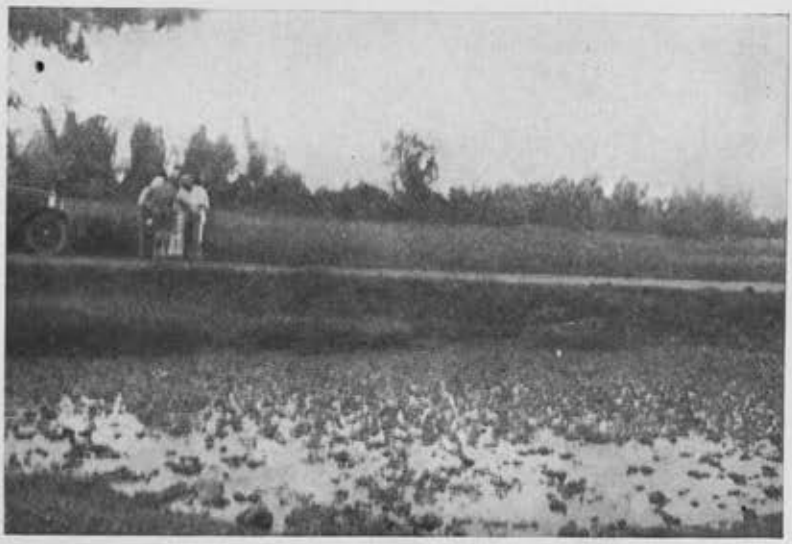

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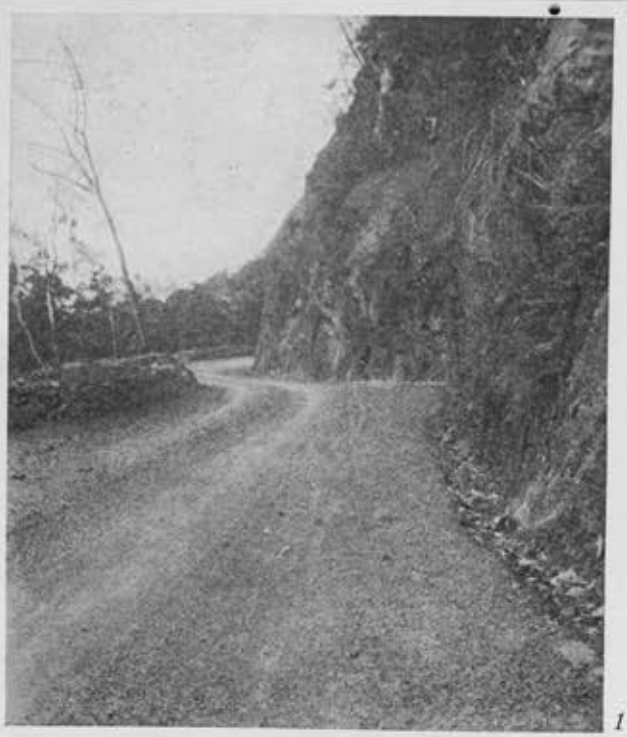
PLATE 3.



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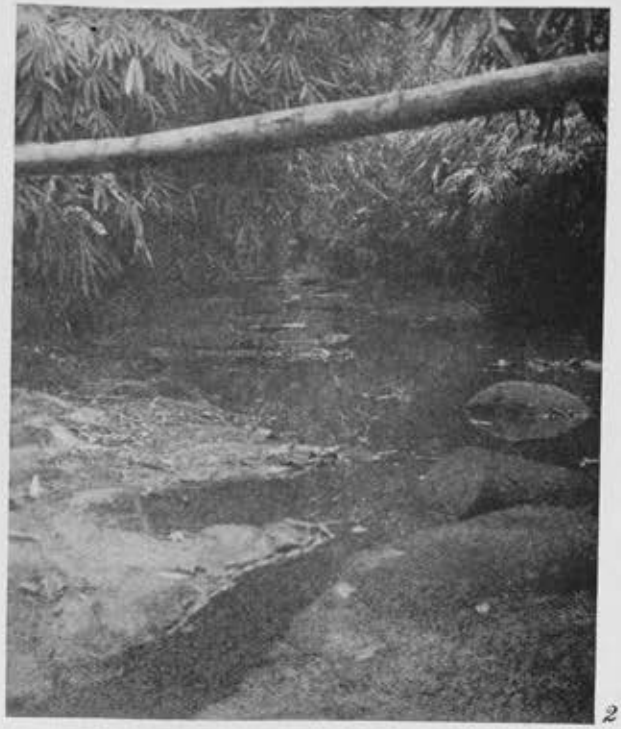

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PLATE 4.

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PLATE 5.

1

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PLATE 6.

PHILIPPINE BLACK CORAL

By RAY N. ALLEN
Chemist, Bureau of Science, Manila

TWO PLATES

Black coral, *Antipathes abies* (Linnæus) Gray, is common in the Philippines and occurs throughout the waters of the Jolo Archipelago, but in larger quantities in Davao Gulf and in the vicinity of Cebu. It has a wide distribution and is also found in the Persian Gulf and around the Great Barrier Reef of Australia. The chief market is in India.[1]

Seale [2] states that the United States steamer *Albatross* dredged large quantities of this "insulated cable wire," as it was called by the sailors, and this term, indeed, is fairly descriptive of the coral. The branches, however, are very numerous and give the small corals a decidedly shrublike appearance.

The axial skeleton consists of thin, concentric, horny lamellæ arranged around an axial lumen, which is usually central in position.

Systematic zoölogical descriptions of *Antipathes abies* are given by Van Pesch [3] and by Brook.[4]

The coral itself is a varnishlike black in color, though in thin sections or powder it is golden brown. The surface of the coral is rough with minute spines, but it can be polished to a glossy jet-black luster, and this, together with the fact that it can readily be bent into any desired form by steaming, when fresh from the water, makes it very suitable for the manufacture of such articles as canes, bracelets, and ring stones. Black-coral articles are sold in the shops and bazaars in Manila but are not produced in large quantities.

In the Philippines the Visayans and Moros secure the black coral by diving from boats and cutting off the stalks with bolos. They dive in perhaps fifteen meters of water with their eyes protected by water-tight goggles. The coral when freshly

[1] Encyclopædia Britannica, 11th ed. 7 (1910) 131.
[2] Philip. Journ. Sci. 6 § D (1911) 307.
[3] The Antipatharia of the Siboga Expedition 73 (1914) 39–42.
[4] Challenger Reports 32 (1889) 170.

gathered is somewhat pliable. The larger pieces, which do not bend so easily, may be softened by immersion in hot water. After the coral has dried thoroughly it is extremely difficult to soften it again for further bending.

Black coral is entirely different from the ordinary concept of a coral, since it is not calcareous or stonelike but an organic substance allied in nature to the chitinous shells of crabs and lobsters. It is probably mainly composed of corneïn[5] ($C_{30}H_{44}N_9O_{13}$).

EXPERIMENTAL PROCEDURE

Three specimens of Philippine black coral were analyzed in this investigation. One was taken from Bureau of Science material and the other two samples were secured from local merchants. All three were quite dry and well-seasoned, but the ages were not known.

The samples for analysis were powdered with a coarse file, and adventitious steel was removed from the powder with a magnet.

Qualitative experiments showed that the black coral was not soluble in the ordinary organic solvents such as alcohol and ether. It reacted with strong nitric or sulphuric acid (1 : 1) with the liberation of the halogens. When treated with sodium or potassium hydroxide (5 per cent) it was decomposed, but there remained a small amount of a colorless horny residue which was probably chitin.

When fused with potassium hydroxide the odor of indol was obtained. Krukenberg[6] states that the black coral which he examined gave indol when heated with potassium hydroxide.

Tests for halogens showed the presence of chlorine and iodine but bromine appeared to be absent. This was verified by Salvador del Mundo, of the Bureau of Science.

The moisture content of the black coral was determined by drying the powdered coral at 105° C. to constant weight.

In estimating the halogens the powdered coral was treated with sulphuric acid and potassium permanganate and the mixture steam distilled. The distillate was absorbed in an alkaline solution. The halogens were thus separated from the organic matter of the coral. The procedure was as follows:

About 0.8 gram of the powdered sample was placed in a half-liter flask with 100 cubic centimeters of 1 : 1 sulphuric acid

[5] Krukenberg, C. Fr. W., Ber. Deutsch. Chem. Ges. 17 (1884) 1843.
[6] Jahresber. der Thier-Chem. 11 (1881) 357.

and 25 cubic centimeters of a saturated solution of potassium permanganate. Steam was passed through this mixture and, together with the evolved halogens, was conducted into well-cooled receiving flasks, each of which contained a mixture of equal parts of sodium hydroxide (5 per cent) and hydrogen peroxide. This steam distillation was continued about forty-five minutes. The absence of halogens in the residue of the distillation flask was verified by testing with silver nitrate.

The solutions in the two receiving flasks were combined, boiled to expel hydrogen peroxide, filtered, and acidified with nitric acid. A measured excess of tenth-normal silver nitrate solution was then added very slowly and the solution boiled to coagulate the precipitated silver salts. The precipitate was dried and weighed as a mixture of silver chloride and iodide. The filtrate containing the excess silver nitrate was titrated by Volhard's method. From these results the percentages of chlorine and iodine were calculated.[7]

The three specimens of Philippine black coral gave the following analyses:

TABLE 1.—*Analyses of Philippine black coral.*[a]

	1	2	3
	Per cent.	*Per cent.*	*Per cent.*
Moisture	7.83	8.03	10.25
Combustible and volatile matter	91.35	91.14	88.13
Ash	0.82	0.83	1.62
Nitrogen [b]	14.20	14.74	12.21
Chlorine	0.34	0.46	0.49
Iodine	4.00	1.36	1.97

[a] Magnesium and calcium were the chief elements found in the ash, with traces of iron and aluminum.

[b] Nitrogen was determined by M. M. Alicante, of the Bureau of Science, using the Kjeldahl-Gunning-Arnold method.

As shown by the data given in Table 1, the percentage of iodine is greater than that of chlorine.

Drechsel [8] examined *Gorgonia cavolinii* for chlorine and iodine. Mendel [9] investigated three allied species of corals, following Drechsel's scheme. These results are presented in Table 2, together with the analyses of *Antipathes abies* obtained in the present study. The halogen content of these corals

[7] Morse, H. N., Exercises in Quantitative Chemistry (1905) 236.

[8] Zeitschr. für Biol. 33 (1896) 96.

[9] Am. Journ. Physiol. 4 (1900–1901) 243.

shows considerable divergence. The percentage of iodine varies from 0.28 to 7.79, and the percentage of chlorine from 0.37 to 3.17.

TABLE 2.—*Analyses of corals for halogens and moisture.*[a]

Species.	Observer.	Moisture.	Chlorine.	Iodine.
		Per cent.	*Per cent.*	*Per cent.*
Gorgonia cavolinii	Drechsel	11.16	2.18	7.79
Gorgonia acerosa	Mendel	13.38	3.17	1.70
Gorgonia flabellum	do	10.44	1.24	1.15
Plexaura flexuosa	do	13.40	0.86	0.28
Antipathes abies (1)	Allen	7.83	0.37	4.34
Do (2)	do	8.03	0.50	1.48
Do (3)	do	10.25	0.55	2.20

[a] Halogens on moisture-free basis.

It is said that some of the people in Java have the interesting custom of wearing black-coral armlets in the belief that these have radioactive properties and are efficacious in warding off certain diseases, notably rheumatism and neuralgia. Tests for radioactivity were made on the black corals used in this research. The determinations were made with a high-grade German electroscope by R. H. Aguilar, of the Bureau of Science. Although a slight radioactivity was indicated it was less than is found in many samples of common well water. Readings were also taken for a pair of polished black-coral bracelets and these gave off no radioactive emanations.

SUMMARY

The variety of coral known as black coral is found in certain waters of the Philippine Islands. Rather handsome articles of jewelry made of it are sold in the Islands, but there is at present no export market. Its production for foreign trade is, however, a possible future industry for the Philippines.

Three specimens of Philippine black coral were analyzed in the course of this investigation. Chlorine and iodine were present in amounts comparable to those found in allied species by other workers. A slight radioactivity was found in the specimens examined.

ILLUSTRATIONS

PLATE 1

Photomicrograph of thin transverse section of black coral; × 10.

PLATE 2

Specimens of Philippine black coral.

PLATE 1.

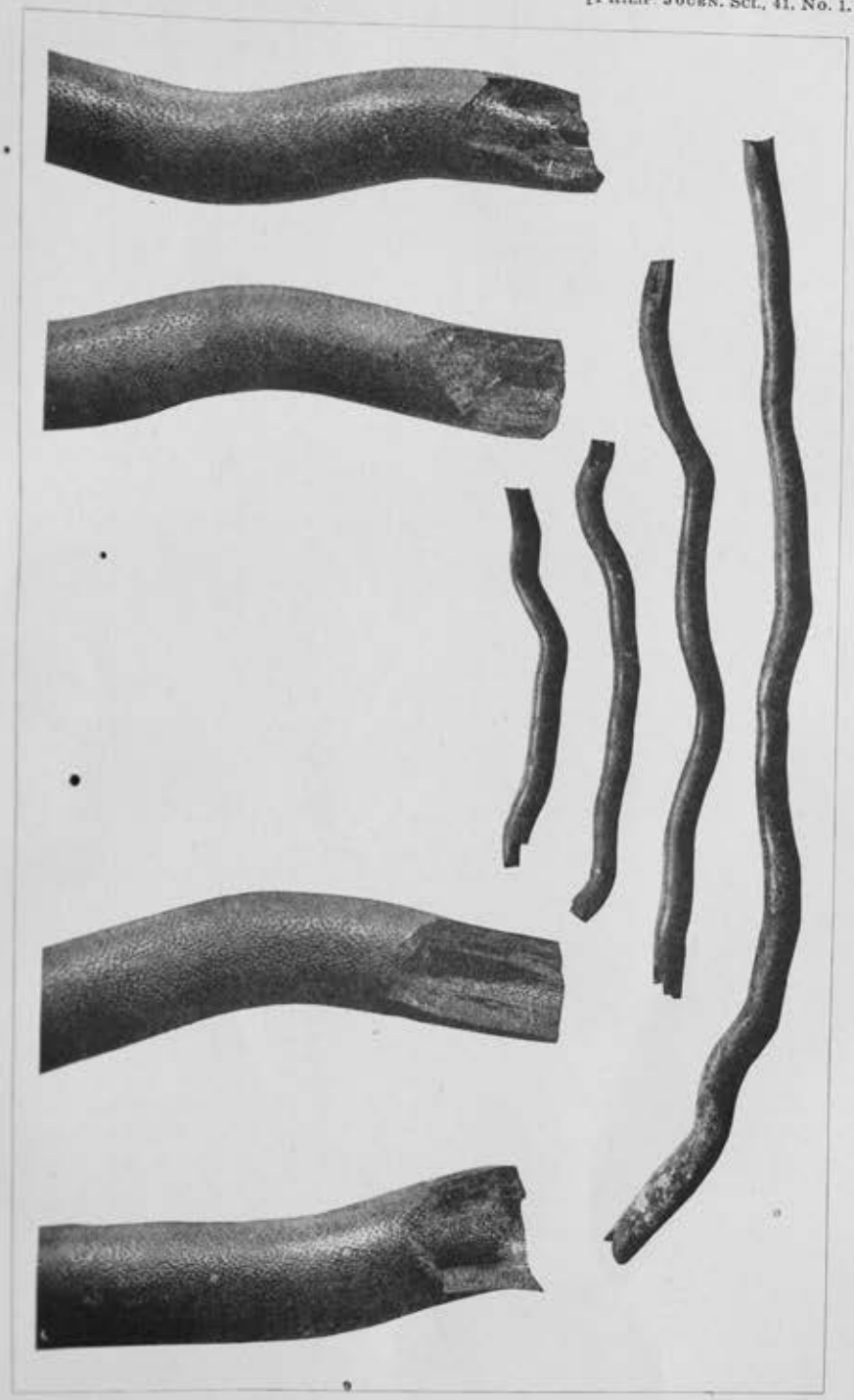


PLATE 2.

THE DETERMINATION OF AVAILABLE ALKALINITY IN COMMERCIAL LIME

By C. M. JOVELLANOS

Junior Chemist, Bureau of Science, Manila

The commonest method of determining alkalinity in lime is by titration with standard acid using phenolphthalein as indicator. It is well known that the end-point of the titration of commercial limes is not a sharp one; the pink color of the indicator returns in a gradually decreasing rate and intensity after several sucessive decolorizations. Repeated experiments with pure calcined calcium carbonate have shown that the end-point is sharp and that the color of the indicator is permanently discharged after the first neutralization.

This behavior of lime on titration led to investigation of the influence of the impurities which are usually found in the commercial article.

Gram samples of pure calcium carbonate were thoroughly mixed with silica (SiO_2), with ferric oxide (Fe_2O_3), and with aluminium oxide (Al_2O_3) in a platinum crucible and heated in a blast burner to constant weight. The alkalinity was determined by titration in the usual way to final decolorization. The added impurities did not all combine with lime (CaO) and after the titration a residue was left consisting of the combined and uncombined portions of the impurity, the former portion being in the form of gelatinous silica, ferric hydroxide [$Fe(OH)_3$] and aluminium hydroxide [$Al(OH)_3$], respectively. In the case of silica (SiO_2) the uncombined portion was determined after the removal of the gelatinous silica with 5 per cent sodium carbonate (Na_2CO_3). In the case of ferric oxide (Fe_2O_3) and aluminium oxide (Al_2O_3) the combined portion was determined after separation with hot dilute hydrochloric acid (HCl) in which the uncombined portion is insoluble.

The period of time necessary for complete decolorization after the first discharge of color is recorded in Table 1.

TABLE 1.—*Influence of impurities on the time required for complete neutralization of commercial limes.*

Combined impurities.	Impurities per 100 parts of calcined product.	Interval between first and final decolorization.	Retardation for 1 per cent impurity.
		min.	*min.*
Silica (SiO_2)	1.76	135	76
Ferric oxide (Fe_2O_3)	2.95	173	58
Aluminium oxide (Al_2O_3)	2.75	90	33

The above experiment shows that acid impurities ordinarily present in commercial limes retard the final end-point. It further shows that silica retards the final end-point to a greater extent than iron, while aluminium has the least effect. Considering that pure calcium carbonate ($CaCO_3$) either partially or completely calcined has a sharp end-point and is permanently decolorized, we can conclude that the return of the color in the titration using phenolphthalein as indicator is due to the impurities in chemical combination with lime as calcium silicates, aluminates, and ferrites. These compounds may be present in the original limestone, but they are probably formed during the process of calcination.

In the literature on the subject of alkalinity determination of commercial lime various methods were found, but that proposed by the American Society for Testing Materials as a tentative method for alkalinity determination is considered one of the best. The method is essentially as follows:

> Place 1.4 grams of carefully prepared and finely powdered (passing thru 100 mesh) sample in a 1-liter graduated flask. Add 400 cubic centimeters of freshly boiled distilled water and boil for 4 to 5 minutes. Cool and add dropwise and with constant vigorous stirring to avoid local excess of acid, which may react with the carbonate, a quantity of acid 5 cubic centimeters less than the required amount as determined approximately in a previous test. Grind up any small lumps with the flattened end of a glass rod, dilute to the mark with freshly boiled distilled water, close the flask with a solid stopper, mix thoroughly for 4 to 5 minutes, and let stand for 30 minutes. Pipette a 200 cubic centimeters portion, add phenolphthalein and titrate slowly with 0.5 N acid (HCl) until the solution remains colorless on standing one minute.

It is to be noted that in this method there is still a return of color and therefore the alkalinity obtained will be lower than the true value. Furthermore, another factor may still lower the results of this method. It is the danger of carbon dioxide

(CO_2) absorption during the taking, transferring, and titrating of the 200 cubic centimeter aliquot portion in the last stage of the procedure, since the solution is still pronouncedly alkaline and the carbon dioxide (CO_2) concentration in an ordinary chemical laboratory is quite significant. This loss of calcium hydroxide [Ca $(OH)_2$] may be negligible but is must be remembered that in the final computation, that used for the aliquot portion is multiplied five times and hence the error is correspondingly magnified. From these considerations and without further adding the effect of the constant and accidental errors inherent in the taking of the aliquot portion, it appears that the American Society for Testing Materials method would be improved in accuracy and simplicity if the pipette were altogether dispensed with and titration carried out and completed on the solution as a whole. It will not then be necessary that the flask be graduated, yet its use is to be recommended because its long narrow neck is a desirable feature in minimizing absorption of carbon dioxide (CO_2). Experiments in this laboratory have shown that by using an Erlenmeyer flask instead of a long-necked flask of the same or larger capacity 0.2 to 0.4 per cent lower alkalinity was obtained in a 1.4 gram sample. This undoubtedly is due to the greater carbon dioxide (CO_2) absorption that takes place in an Erlenmeyer flask. The method of determining the alkalinity in commercial lime as now carried out in this laboratory is as follows: Powder the sample of lime to pass through a 100-mesh sieve. Take from 1 to 1.5 grams of the prepared sample for analysis; introduce into a volumetric flask of 1-liter capacity. Add from 600 to 700 cubic centimeters of recently boiled distilled water and boil the contents of the flask from four to five minutes. Cool and add a few drops of phenophthalein indicator and titrate with standard acid dropwise, and stir constantly until the solution is nearly decolorized. Grind up any small lumps with the flattened end of a glass rod. Close the flask with a tight-fitting stopper, allow to stand for half an hour, and then titrate again until the solution remains colorless on standing for one minute. It will be noticed that the method differs from the tentative method of the American Society for Testing Materials only in that complete titration is carried out in the same flask.

A comparative test of the two methods using a high calcium lime containing 0.33 per cent silica and 0.58 per cent iron and aluminum oxides gave the results recorded in Table 2.

TABLE 2.—*Comparative test of methods.*

Method used.	Volume of acid used.			Alkalinity as lime (CaO).		
	First decolorization.	Thirty minutes after first decolorization.	Final decolorization.	First decolorization.	Thirty minutes after first colorization.	Final decolorization.
Modified American Society for Testing Materials using 1.4 grams	61.47	61.54	61.59	94.26	94.37	94.44
Modified American Society for Testing Materials using 0.7 gram	30.70	30.73	30.75	94.15	94.25	94.31
American Society for Testing Materials	----------	61.35	----------	----------	94.08	----------

SUMMARY

A pure lime, containing no silica, iron, or alumina, has a sharp end-point on titration with acids and is permanently decolorized. With commercial limes, however, the end-point is not sharp and the color of the phenolphthalein indicator returns. It has been shown that this is due to the impurities found ordinarily in the limestone; namely, silica, iron, and alumina. During the calcination process, these impurities combine with lime and form compounds which slowly hydrolize in water. The silicate of calcium has a greater retarding effect on the end-point than either aluminum or iron compounds of calcium.

The method followed in this laboratory for the determination of alkalinity of commercial limes has been given and differs from the tentative method of the American Society for Testing Materials in that complete titration is carried out in the same flask without the necessity of diluting the solution to exactly 1 liter and taking an aliquot portion thereof. This procedure is believed to be simpler and comparative results of the two methods showed that the method as followed in our laboratory using different weights of sample gives a result of about 0.2 per cent higher alkalinity than the American Society for Testing Materials method.

ACKNOWLEDGMENT

This investigation was carried out at the suggestion and under the direct supervision of F. D. Reyes, chief of the division of inorganic chemistry, Bureau of Science.

POTABLE ARTESIAN WATER IN RIZAL PROVINCE, LUZON

By A. D. ALVIR

Geologist, Division of Geology and Mines, Bureau of Science, Manila

TWO TEXT FIGURES

The problem of drinking water is as yet unsolved for Pateros, Rizal, and its vicinity. The inhabitants obtain their water from Makati (San Pedro Macati) or Pasig. Two wells have been bored in the town of Pateros, but both yield salt water unfit for any domestic use. The purpose of the present investigation is to locate the best site for a well that will yield potable water.

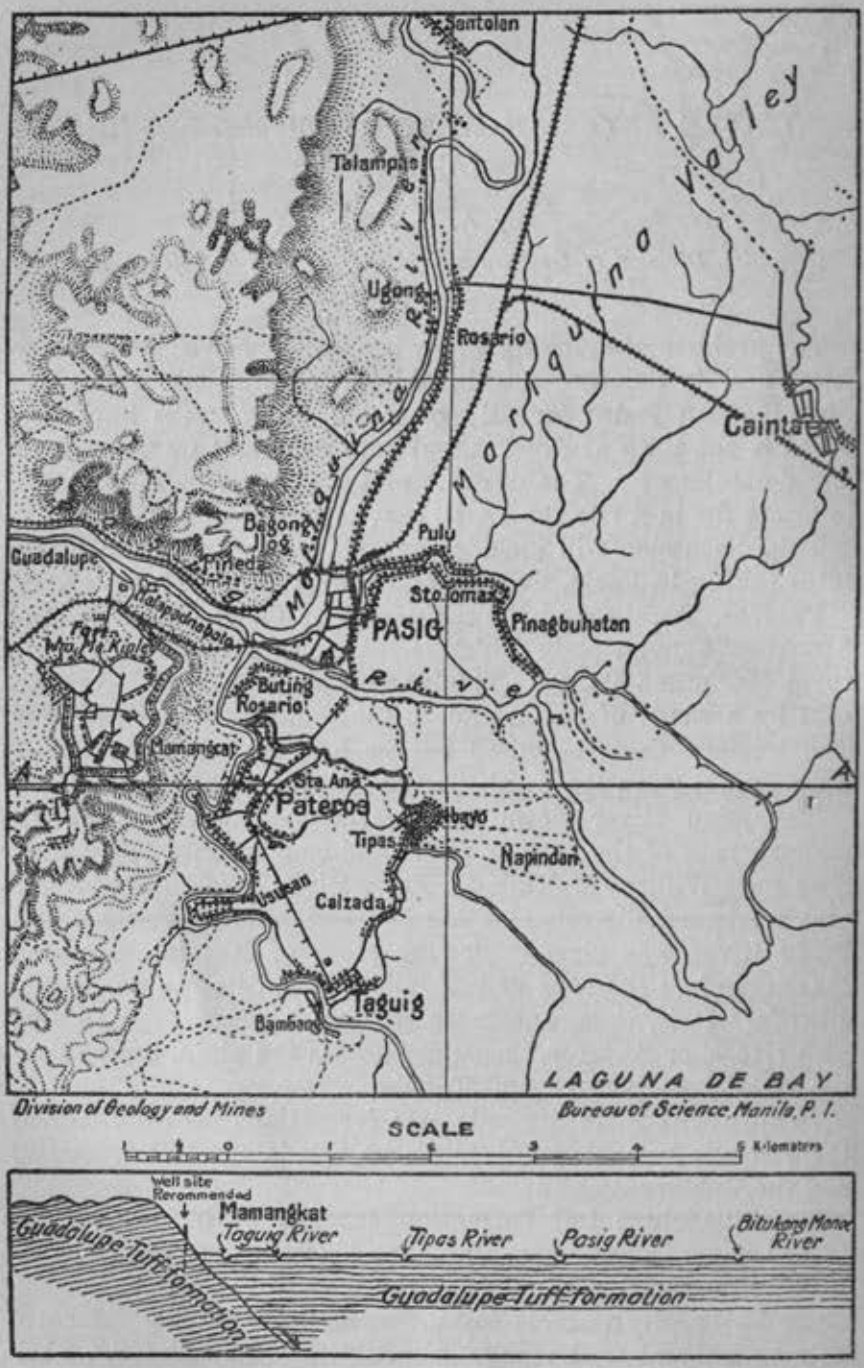
This discussion will include the area north and south of Pateros taking in Pasig, Taguig, and Fort William McKinley.

Pateros, Taguig, and the main part of Pasig are situated on a narrow alluvial plain which is the continuation of the structural Mariquina Valley. This narrow plain is bordered on the east by a range of basalt and on the south by Laguna de Bay. The western part is limited by low hills of volcanic tuff with a maximum elevation of about 120 feet above sea level.

Mariquina River flows southward, meandering along the western part of the narrow plain, and empties into Pasig River near Fort William McKinley. Pasig River here flows in a general westward direction across the low hills of volcanic tuff. Pasig River was already flowing more or less in its present channel before the area of tuff hills was uplifted to the present altitude. It is, thus, antecedent to the structure. Small sluggish rivers, or "esteros," meander across the plain, especially in the vicinity of Pateros and Taguig.

In this area there are only two formations present; namely, the Pliocene volcanic tuff, called the Guadalupe tuff formation, and the Quaternary alluvium.

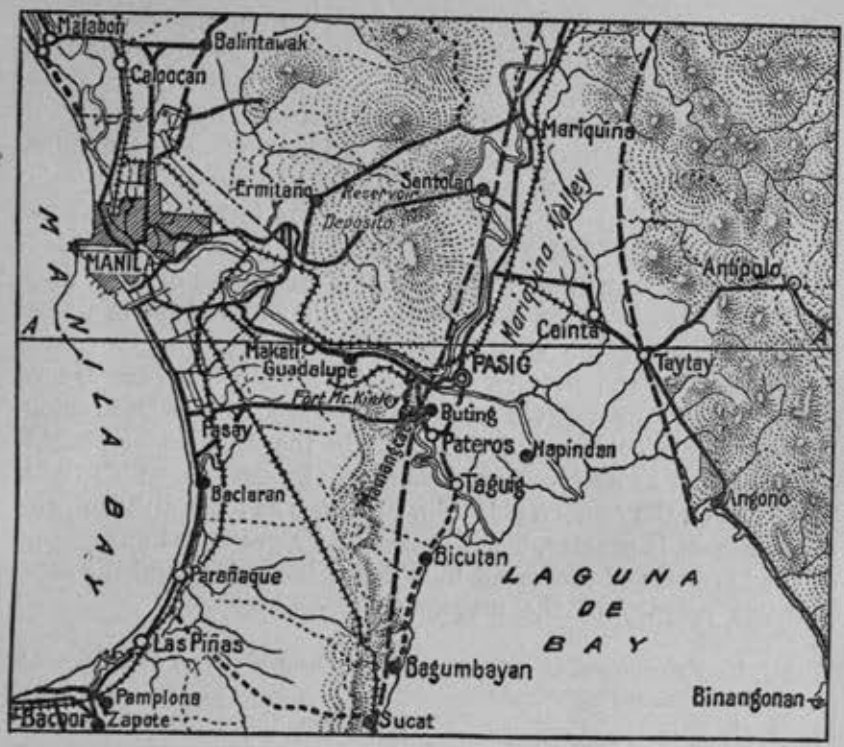
The Guadalupe tuff formation consists of bedded volcanic tuff varying from fine to coarse, and gravelly, sandy, or shaly. It is well exposed in the hills to the west of the plain, especially along Pasig River. This formation makes a good water reservoir on account of its great porosity. It underlies the whole region and is also encountered below the alluvium in the plain.



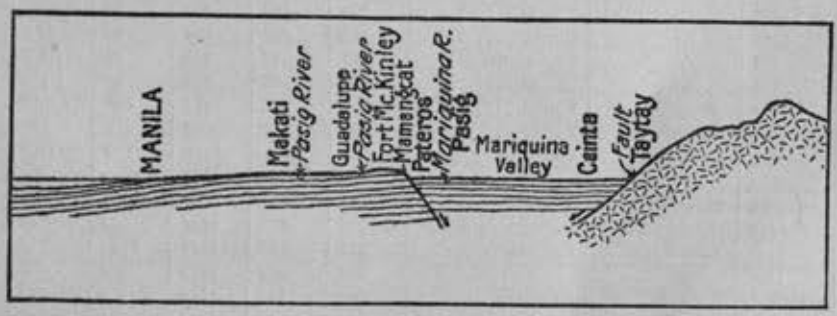
DIAGRAMATIC CROSS SECTION A A EAST AND WEST THROUGH PATEROS

Vertical scale exaggerated 20 times

FIG. 1. The vicinity of Pasig, Pateros, and Taguig, Rizal Province, Luzon; and a diagrammatic cross section east and west through Pateros.



Map showing the two faults on either side of Mariquina Valley
Fault line ——————
SCALE 1 2 0 1 2 3 4 5 6 7 8 9 10 Km.



Cross section east and west across Pasig along A A showing the structure of Mariquina Valley
Vertical scale exaggerated 10 times

FIG. 2. The fault on each side of Mariquina Valley; and a cross section east and west through Pasig, showing the structure of Mariquina Valley.

The Quaternary alluvium is found in the plain, and was certainly deposited there by the rivers. Here and there, especially near Laguna de Bay, fine lake silts are encountered.

The valley of Mariquina River is structurally a graben, a trenchlike depression due to a downward movement of the valley strip along two normal faults, one on either side. These relations are shown in the map of fig. 1. The lower figure shows the cross section east and west through Pateros.

It is clearly seen that in the upthrow side, west of the valley, the sediments dip to the west, while in the valley there is almost no inclination of the strata.

The fault on the western part of the graben has been traced north beyond Angat River and south to the Taal Volcano region. Physiographic evidence of this fault in the area under consideration is not so clear-cut on account of the easily erodible tuffs. The fault on the eastern side (fig. 2) is not as long, although the displacement is greater, but it is excellently preserved on account of the hardness of the basalt in which it took place and the comparative recency of the movement.

TABLE 1.—*Tabulations of artesian wells in Pasig, Pateros, and Taguig.*[a]

Well No.	Town.	Barrio.	Depth.		Parts per million.[b]		
			Total.	Cased.	Total solids.	Chlorides.	Sulphates.
			Feet.	*Feet.*			
1026	Pasig	Santalan	305	267	340	33	0
1585	do	do	250	180	390	20	6
1526	do	Ugong	370	354	540	96	19
753	do	Bagong-Ilog	315	113	395	44	(c)
793	do	do	130	98	370	20	(c)
1509	do	Pineda	320	264	415	100	16
1527	do	Buting	255	40	*1200*	*510*	*43*
380	Pateros	Poblacion	116	.....	*2422*	*1127*	(?)
1914	do	do	85	64	*3000*	*1250*	1
1236	Taguig	Tipas	310	290	*1009*	*224*	*98*
1198	do	Palingon (Tipas)	265	253	*1167*	*263*	20
1159	do	Calzada	172	169	*2120*	*1100*	.....
1159	do	do	240	230	*1268*	*330*	(c)
1179-A	do	Bambang	360	340	*1513*	*307*	163
1179-A	do	do	310	300	*1234*	*211*	*62*
1130	do	Hagonoy[d]	280	265	*1267*	*253*	*116*
			280	271	*1023*	*219*	*122*
1037	do	Usasan	595	585	*2340*	*800*	*110*
					2270	*790*	*100*
1168	do	Bagongbayan	150	136	580	74	19

TABLE 1.—*Tabulations of artesian wells in Pasig, Pateros, and Taguig.*[a]—Continued.

Well No.	Gallons pumped per minute at depth of water in feet.	Quality of water.	Analyst.	Remarks.
1026	10 at 10	Very good	J. G. Nuñez	Near hills, west of fault.
1585	10 at 13	do	P. G. Rivera	Do.
1526	10 at 13	do	do	Tuffs, west of fault.
753	60 at 63	do	F. Peña	Water obtained at 160 feet; in tuff hills.
793	60 at 60	do	J. G. Nuñez	Water obtained at 130 feet; in tuff hills.
1509	15 at 15	do	P. G. Rivera	In tuff hills.
1527	10 at 15	Poor	do	Brackish; in plain east of fault.
380	25 at 25	do	V. Q. Gana	Turbid and salty; in plain east of fault.
1914	20 at 22	do	R. H. Aguilar	Salty; in plain east of fault.
1236	10 at 40	Fair	do	Taste normal; in plain east of fault.
1198	10 at 20	do	do	Do.
1159	10 at 45	Poor	do	Salty; in plain east of fault.
1159	10 at 40	Fair	do	Normal taste; in plain east of fault.
1179–A	10 at 60	Poor; turbid		Iron taste; in plain east of fault.
1179–A	10 at 13	Fair		Normal; in plain east of fault.
	15 at 40	Poor; turbid	R. H. Aguilar	Iron taste; in plain east of fault.
1130	10 at ?	Fair	do	Normal taste.
1037	10 at 15	Poor; turbid	J. G. Nuñez	Brackish; in plain east of fault.
1138	15 at 6	Very good	R. H. Aguilar	Still west of fault in tuff hills but south of Taguig proper.

[a] Analyses made by the Bureau of Science, Manila.
[b] *Italic* figures denote high mineral content.
[c] Trace.
[d] Two samples, taken at different depths and different times.

A study of the accompanying tabulation of the wells drilled in the surrounding region has led to the following conclusions:

1. Wells drilled in the plains east of the western fault of Mariquina Valley yielded water with total solids ranging from 1,009 to 3,000 parts per million. These amounts are excessive.

2. The water from the wells west of the fault line in the tuff hills contains total solids varying from 340 to 540 parts per million only. These amounts are low.

3. The water of the wells in the plains contain from 211 to 1,250 parts per million of chlorides, making the water taste brackish or salty.

4. The water from the wells west of the fault contains only from 18 to 100 parts per million of chlorides, and the taste is normal.

5. The underground waters from the plains east of the fault generally contain more sulphates than the water in the tuff hills west of the fault.

6. Generally the deeper the well, the more mineralized the water becomes.

In Fort William McKinley, down to depths of about 600 feet good drinking water was obtained but at about 1,000 feet the water was too salty to drink.

The barrio of Bagongbayan of the town of Taguig is located to the south of the town, on Laguna de Bay, and is not shown in the map. This is taken up separately because it might be taken as though it were on the plains east of the fault. While it is situated on Laguna de Bay, it is still west of the fault line, since this fault here borders Laguna de Bay. Its topography is that of low tuff hills. The artesian water produced in Bagongbayan is of very good quality.

There is a vast difference in the chemical content of the artesian waters east and west of the fault line. Since the sediment, the Guadalupe tuff formation, from which these waters come is the same in both cases it is evident that the anomaly is not due to the underlying rocks.

The explanation of this phenomenon may lie in the structure and its influence on the circulation of underground water. The cross section in fig. 1 shows readily that the sediments west of the fault line are dipping westward, while east of the fault line they are almost flat. Naturally there is more circulation of the ground water in the inclined strata, and in the horizontal sediments the ground water should be more or less stagnant, or at least very sluggish. Where there is more circulation the original salts included in the deposition of the sediments have been more thoroughly rinsed or washed out. The high content of chlorides and sulphates seem to denote that there still remain appreciable quantities of the salts of the original ashes or the sea water in which the stratified tuffs were deposited or of both. This same idea holds for the difference of composition between waters at different depths. The waters nearer the surface generally have less mineral content because there is more circulation of the ground water in the upper zones than in the lower.

Pasig is getting its water supply in the barrio of Bagong Ilog, west of the fault line, and the water is excellent. There are two wells, each pumping 60 gallons per minute. The water at the barrio of Tipas, Taguig, while it can be used for drinking, is still highly mineralized. Therefore, it is recommended that for Pateros the well be drilled in the barrio of Manangkat, in the foothills of Fort William McKinley, because the chances for good water there are much greater than at any other site. Water can be pumped to a tank which will supply Pateros with running potable water. It would be better to drill the well at the proper elevation in the hills near Fort William McKinley so that the high structure which would be needed for the tank may be eliminated. The transportation of machinery, such as the drilling rig and the pumping machinery should also be taken into consideration in the selection of the well site. In the tuff hills west of the fault line, the probability for obtaining excellent water is great. A flowing well should not be expected in this region.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Map of the vicinity of Pasig, Pateros, and Taguig, Rizal Province, Luzon; and diagrammatic cross section east and west through Pateros.

2. Map showing the fault on each side of Mariquina Valley; and cross section east and west through Pasig, showing the structure of Mariquina Valley.

COMPOSITION OF SOME PHILIPPINE FRUITS, VEGETABLES, AND FORAGE PLANTS

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TWENTY-TWO PLATES

INTRODUCTION

Various Philippine foods have been analyzed by Agcaoili and his associates, and a summary of the results has been given by Agcaoili.[1] With the accumulation of more data Wester[2] compiled a larger list of analyses, many of which were published for the first time. A compilation of analyses of Philippine foods and forages was also given by Adriano[3] and by Santos and Adriano.[4] Three other articles on the analysis of Philippine foods have been published in the Philippine Journal of Science.[5]

In the present paper are recorded the analyses made by Valenzuela of various fruits, vegetables, and forage plants furnished by the Bureau of Agriculture. Mr. Mariano Manas y Cruz, chief of the plant industry division, provided the Payyang and Sinamba bananas, guamá, hevi, cyndra, papache, pulau, chayote, and one of the zapotes. All other specimens were obtained from the sources cited by Wester who contributed the descriptions. The photographs were furnished by the Bureau of Agriculture and by the Bureau of Science.

DESCRIPTIONS

MUSA SAPIENTUM Linnæus. Banana.

The banana is represented in the Philippines by many varieties. Plate 1, fig. 1, represents a small pink banana which

[1] Census of the Philippine Islands 3 (1921) 917.
[2] Bureau of Agr. Bull. 39 (1924) 212–221.
[3] Philip. Agriculturist 14 (1925) 57.
[4] Report of the Office of the Public Welfare Commissioner (1928).
[5] Philip. Journ. Sci. 28 (1925) 453; 36 (1928) 157–235.

grows in small bunches. It was obtained without variety name from Guam. The fruits are so small and lacking in flavor and aroma as to make this variety of no more than passing interest, and of no value as a market fruit.

The Sinangil (Plate 1, fig. 2) is a variety grown in Leyte and other parts of the Visayas. The bunch is small and the variety is less productive than varieties like the Latundan and Lakatan. The fruits are slender, light yellow, and thin-skinned. The flesh is sweet and aromatic and of fine quality. The flavor is distinctive, somewhat like the maráng, *Artocarpus odoratissima*. Seeds are produced occasionally. The sample was procured in Tacloban, Leyte.

The Pinipita (Plate 2, fig. 1) is dark green and larger than the Sinangil. The bunches are moderately long, and the hands are thickly crowded on the stem. It is a fairly large, coarse banana of little value if eaten raw, and chiefly useful as a cooking banana. The sample was procured in Tacloban, Leyte.

The Inaldaba (Plate 2, fig. 2) is a cooking banana similar to the Sabá except that the bunches are small. However, the people in Palo, Leyte, where the sample was procured, insist that it is distinct from the Sabá.

The Payyang (Plate 3, fig. 1) is a variety from Ilagan, Isabela. It is a large, yellow, curved fruit with a gradual taper toward the apex and a long shank. The skin is medium thick, tough, and fibrous; the flesh is yellow. It is inedible raw, but is suitable for cooking. Apparently it is a variant of the Tinduk, which it resembles in its small bunches.

The Sinamba (Plate 3, fig. 2) also is variety from Ilagan, Isabela Province, in northern Luzon. The fruits are light orange, short and stout, flattened, and moderately curved, and resemble the Sabá. The skin is pulpy and brittle, and does not peel. The flesh is rich yellow, sweet, and aromatic, and has a fair to good flavor.

The San Juan is a variety found in Ilocos Norte. The bunch is small to medium sized, and has up to eleven fingers on a hand. The fruits are dull yellow, stout, and coarse, slightly curved, sharply angled, about 15 centimeters long; the nose is compressed and long. The flesh is meaty, and the texture is like that of a cherry. It is of poor quality, and is best when fried.

CALAMUS ORNATUS Blume var. PHILIPPINENSIS Beccari. Kalapi. Plate 4.

The kalapi is a coarse spiny rattan of vigorous growth with pinnate leaves. The fruit is borne in large bunches. The

fruit is scaly, short-oblong with a pointed tip, and yellowish with brown markings and contains a large seed. The flesh is brownish and somewhat fibrous but juicy. There is considerable variation in the quality of the fruit from different plants, some is sweet and of good flavor, while some is very acid. It makes an excellent jelly and fruit sirup. When in season the fruit is common in the markets in Samar, Leyte, Tayabas, Laguna, and Surigao, and apparently is well liked.

The kalapi is of wide distribution in the Philippines from northern Luzon to southern Mindanao. The samples were procured in Tacloban, Leyte.

INGA LAURINA Willdenow. Guamá. Plate 5, fig. 1.

The guamá is a handsome tree about 15 meters high. It has dark green shining leaves and cylinder-shaped, leathery, greenish pods which contain a sweet, juicy, white pulp, not unlike that of the kamanchile, *Pithecolobium dulce*. The pods are commonly marketed in Porto Rico and other parts of tropical America. The tree also serves as a shade tree for coffee.

It was introduced into the Philippines in 1918. The sample grew at the Lamao experiment station.

FERONIA LIMONIA Swingle. Vilatti. Plate 5, fig. 2.

The vilatti is a small, thorny, deciduous tree about 15 meters high, It has pinnate leaves with small glossy leaflets, and small dull-red flowers. The fruit is round, gray, about 8 centimeters in diameter, and has a hard bony shell, containing the pinkish, subacid, edible pulp in which numerous, small, woolly seeds are embedded.

The vilatti is native in India and in 1913 was introduced into the Philippines at the Lamao experiment station whence the sample was obtained. In India the fruits are eaten with oil, and salt and pepper, and are made into a jelly said to resemble that made of black currants.

SPONDIAS CYTHEREA Sonnerat. Hevi. Plate 6, fig. 1.

The hevi is a large deciduous tree 20 meters high with pinnate, glossy, bright green leaves. The fruit is about the size of a large hen's egg, dull amber, subacid, and aromatic. The large seed radiates coarse fibers through the flesh, which may be eaten raw, preserved, or made into a fine jelly.

The hevi is native of Polynesia, was introduced into the Philippines in 1912, and in 1915 fruited at Lamao where the sample grew.

AMPELOCISSUS MARTINI Planchon. Bika. Plate 6, fig. 2.

This is a large woody annual vine growing from a tuberous root. It has three-lobed leaves, which are dark green and shining above and russet beneath. It differs from the plants of this species collected elsewhere in its hairy vines and petioles. The small, dark purple to almost black fruits are borne in bunches like grapes, and are juicy and acid. They are too sour to be eaten uncooked, but make excellent jelly similar to grape jelly.

The fruit samples were presented by Mr. John R. Wilson, Manila, who has growing in his garden two vines brought from Mindoro.

DILLENIA MINDANAENSIS Elmer. Kambóg. Plate 7, fig. 1.

The kambóg is a medium to large tree with a straight trunk. It has large broad-toothed leaves, and large, handsome, yellow flowers. The fruits are roundish, pale green, and smooth. The fleshy arils in the centers are covered by the large, fleshy, persistent sepals. They make good preserves.

The kambóg is found in Mindanao, but has been domesticated at the Lamao experiment station where the sample was procured.

FLACOURTIA RAMONTCHI L'Herit. Serali. Plate 11, fig. 2.

The serali is a shrub or a handsome round-topped tree about 8 meters high. The trunk and larger branches are spiny. The fruit is roundish, about 25 millimeters across, dark purple, smooth, fleshy, juicy, and subacid. The best forms have an excellent flavor. The fruit contains several small seeds.

The serali is native of India and Madagascar and was introduced into the Philippines in 1915. For many years it has fruited at the Lamao experiment station, whence the sample was obtained.

FLACOURTIA RUKAM Zollinger and Morran. Rukam. Plate 7, fig. 2.

The rukam is a small tree, from 6 to 10 meters high. The dark purple fruit is about the size of a cherry, and is fleshy, juicy, subacid, and edible, and contains several small seeds.

The rukam grows wild in the Philippines where it is widely distributed at low and medium altitudes, and is found wild or cultivated from India to Indo-China and the Malay Archipelago. The analysed sample was presented by Mr. Harold Cuzner, forester in charge of the School of Forestry, Los Baños, Laguna.

DIOSPYROS DISCOLOR Willdenow. Mabolo. Plate 8.

The mabolo is a tree 8 to 15 meters tall, with dark green leaves. The tree yields a very hard wood commonly known as

kamagón. The velvety reddish fruit is generally round, about the size of an apple. The flesh is cream-colored, somewhat dry and astringent, but sweet and aromatic, and incloses eight large seeds. Occasionally trees are found bearing seedless fruits which are flatter than the seedy ones, sometimes becoming almost disklike, like the Valesca (Plate 8, fig. 1).

The fruit of the Valesca is exceptionally large, and flatter in proportion to the length than any other mabolo known. Though it has the superior characteristic of seedlessness, it is deficient in sweetness and flavor and unlikely to become commercially valuable. However, it may be useful for breeding purposes.

The original tree of this variety grows on the Roxas hacienda, Calauan, Laguna. The fruit samples were presented by Mr. John R. Schultz, manager of the estate.

The Rizal mabolo (Plate 8, fig. 2) originated on the homestead of Mr. Mauricio Santiago, Navotas, Rizal Province. This fruit is relatively small, rarely more than 7 centimeters in diameter. While distinctly flattened it is more nearly round than the Valesca. The flesh is sweet and juicy, slightly astringent, and of good eating quality.

The fruit samples were presented by Mrs. Santiago through Mr. A. W. Prautch, chief of the rural credit division, Bureau of Agriculture.

DIOSPYROS EBENASTER Retzius. Zapote. Plate 9, fig. 1.

The zapote is a dark green tree about 13 meters high. The green fruit is shaped like a tomato, but is larger. It is often 10 centimeters or more in diameter, and contains a dark brown, sweet, aromatic, edible pulp.

The zapote is a native of Mexico but was introduced long ago into the Philippines. Sample 1 was presented by Mr. John P. Egan, park superintendent, Manila, and sample 2 came from the Lamao experiment station.

CYPHOMANDRA BETACEA Sendter. Cyndra. Plate 9, fig. 2.

The cyndra is a semiherbaceous shrub 2 to 4 meters high, with large, cordate-ovate, velvety leaves 20 to 30 centimeters long. The ovoid, smooth, yellowish-red to purplish fruits average about 5 centimeters in length and have juicy subacid, agreeably flavored flesh containing many small seeds about the size of tomato seeds. The fruits may be eaten raw, but are better when cooked with sugar or made into jelly.

The cyndra is native of the highlands of Peru where it is of ancient cultivation. It was successfully introduced into the

Philippines in 1917, where it is grown chiefly in Baguio. The sample was furnished by Mr. Modesto Dirige, superintendent of the acclimatization station in Baguio, who also sent the samples of the muti, water cress, the Dallis and Kikuyu grass, alfalfa, and the clovers.

SOLANUM NIGRUM Linnæus. Muti. Plate 10, fig. 1.

The muti is an erect branching herb about 60 centimeters high, with alternate, usually ovate leaves about 10 centimeters long. The flowers are small and white. The fruits are black, round to flattened, and juicy but insipid, and are about 12 millimeters in width.

The muti is a common weed of wide distribution in both the Tropics and the temperate zones. In the Philippines it is found up to 2,000 meters altitude. The present sample was grown at the Baguio acclimatization station, Bureau of Agriculture. It is an improved form obtained from the United States under the name of garden huckleberry. Both in Baguio and Manila it has been found to thrive and yield abundantly, and it may be a useful fruit for stewing and preserving.

RANDIA ECHINOCARPA Moc and Sessé. Papache. Plate 10, fig. 2.

The papache is a shrub or a small tree with sharp, stout spines. It bears large orange-colored flowers, about 14 centimeters long. The fruit is egg-shaped, and velvety, has many spiny projections, and contains a black, soft, jamlike, edible pulp inclosed in a hard shell.

The papache is a native of Mexico, and was introduced into the Philippines by the Bureau of Agriculture, and in 1927 fruited at the Lamao experiment station where the sample grew.

PERSEA AMERICANA Miller. Avocado. Plate 11, fig. 1.

The avocado is a medium-sized to large tree, often more than 10 meters high. The fruits are round, oblong, or bottle-shaped; green, red-purple, or black; and weigh about 2 kilograms.

The Alegre avocado is a bottle- or kidney-shaped green fruit of excellent eating quality. The parent tree was raised from a seed imported from Hawaii twenty years ago, and planted by Mr. John R. Wilson at his home, Vista Alegre, in San Juan del Monte, Rizal, after which it has been named.

CICCA ACCIDA (Linnæus) Merrill. Iba. Plate 12, fig. 2.

The iba is a small tree 6 meters high. The waxy greenish-yellow fruits are borne in currantlike racemes, usually on old

wood. They are roundish, flattened, about 15 millimeters across, with sour flesh containing a stone. Trees bearing mildly acid or even subacid fruits have been found recently in the Philippines.

The iba is an introduction of old standing and rather wide distribution in the Philippines. The sample was procured in Tagudin, Ilocos Sur.

CITRUS AURANTIFOLIA Swingle var. AROMATICA Wester. Dalaya. Plate 12, fig. 1.

This is a spiny shrub rarely more than 4 meters high. The fruits are more or less lemon-shaped, but are smaller and the rind is thin and lighter yellow than the lemon. The juice is abundant and makes a refreshing drink. Excessive seediness is the principal defect of the fruit. The sample was presented by Dr. G. W. Daywalt, San Jose, Mindoro.

CYRTOSPERMA MERKUSII (Hasskarl) Schott. Palauán or Palau. Plates 13 and 14.

The palauán is an aroid of exceedingly robust and characteristic growth, with very large broad leaves, often 3 meters high, growing from a large stout starchy rootstock which is used for food, especially when other food is scarce.

The palauán grows in swampy soils, and is found from southern Luzon to New Guinea. The sample was procured in Tacloban, Leyte.

ALOCASIA MACRORRIZA (Linnæus) Schott. Biga. Plate 15.

The bíga is a tall herb with large broad leaves and a stout, starchy stem sometimes meter-high. It is sparingly cultivated.

The bíga ranges from India, through Malaya and the Philippine Islands, to Australia. The sample was procured in Surigao.

NYMPHAEA NOUCHALI Burman f. Pulau. Plate 16.

A perennial aquatic herb growing in shallow water from a tuberous starchy rhizome. It has large floating rounded leaves, and white flowers, which expand at sunrise and close at sunset. The tubers are gathered, boiled, and eaten. The many small seeds embedded in the mucilaginous pulp are also used for food. The pulau is of wide distribution in tropical Asia and Malaya where it is also used for food.

CANARIUM COMMUNE Linnæus. Kanari. Plate 17, fig. 1.

The kanari is a large handsome tree, sometimes more than 20 meters high. The fruit is shaped like an elongated olive, is about 5 centimeters long, and is smooth and black. It contains an oblong brown nut with a thick, hard, bony shell in which

are inclosed two or three kernels. These kernels are of excellent quality either raw or roasted, but are smaller than the kernel of the commercial Philippine pili.

The kanari is a native of the Moluccas, and has been introduced successfully into the Philippines. There are several fruiting trees in the Jolo provincial orchard whence the sample was obtained.

ARTOCARPUS ODORATISSIMA Blanco. Maráng. Plates 18 and 19, fig. 1.

The maráng is a handsome tree about 20 meters high, with large, rough, dark-green leaves. The fruit is roundish, and thickly studded with straight, blunt, stiff, brown spines. The flesh is creamy white, sweet and aromatic, and has an excellent flavor. The seeds are about twice the size of a peanut kernel, and are roasted and eaten.

The maráng is probably a native of Borneo but has been in the Philippines so long that it is generally regarded as a native fruit. It is common in Basilan and Jolo; the sample was obtained from the latter place. It also grows in Zamboanga, Lanao, and Cotabato.

EUSIDEROXYLON ZWAGERI Teysmann and Binnendijk. Tambúlian. Plate 17, fig. 2.

The tambúlian is a large timber tree found from Tawitawi, Sulu Archipelago, to Borneo. The fruit consists of an oblong slightly curved and corrugated woody shell inclosing a large seed. It is not used for food, though it is rich in nutritive elements, especially carbohydrates.

The specimens were procured in Tawitawi by Mr. J. A. Wright, of the Bureau of Education.

TALINUM TRIANGULARE Willdenow. Talinum. Plate 19, fig. 2.

The talinum is an erect branching herb with oblong fleshy leaves and small pink flowers. The tender leaves and tops are quite extensively used as greens in various parts of the Tropics. It is easily propagated from cuttings.

The talinum is native of the West Indies, and was introduced in 1915 from Java into the Philippine Islands where it is gradually becoming disseminated. The sample was obtained from the Singalong experiment station, Manila.

MANIHOT UTILISSIMA Pohl. Cassava.

The cassava is an erect woody plant 2 to 3 meters high, producing large roots rich in starch. The tender tops and leaves are eaten like spinach.

This plant was introduced from Mexico in the early colonial period, and is now of pantropical distribution. The sample was obtained from the Pandacan research laboratory, Manila.

PISONIA ALBA Spanoghe. Malúko.

The malúko is a small tree about 10 meters high with stout trunk. The leaves are large, oblong-ovate, pointed, pale green, and 12 to 25 centimeters long. The tender leaves make good greens.

It is planted in the Philippines and many other parts of tropical Asia, chiefly as an ornamental tree.

GLIRICIDIA SEPIUM (Jacquin) Steudel. Kakauáti. Plate 20, fig. 1.

The kakauáti is a small unarmed deciduous tree about 10 meters high, and has pinnate leaves up to 25 centimeters long. The handsome pinkish flowers are borne in profusion on the bare branches. In Salvador, Central America, the flowers are eaten cooked. They are sometimes used for food in the Philippines. The trunk is used for house construction and the branches for fire wood. The young growth is sometimes fed to cattle.

The kakauáti is a native of Mexico and was long ago introduced by the Spaniards into the Philippines where it is common. The peculiar odor of the crushed leaves and bark is due to the presence of coumarine.

SECHIUM EDULE Swartz. Chayote. Plate 20, fig. 2.

The chayote is a perennial climbing or trailing vine growing from a tuberous starchy root. It is related to the squash and the melon. The fruit is somewhat pear-shaped, about 10 centimeters long, is wrinkled, pale green to white, and covered with sparse spines. A large seed protrudes at the end of the fruit. It makes an excellent vegetable when prepared like squash. The starchy tubers and the tender tops also may be eaten.

The chayote is native of the West Indies and was introduced into the Philippines in 1920. It thrives best at elevations above 450 meters, and flourishes in Baguio whence the present sample was obtained.

NASTURTIUM OFFICINALE R. Brown. Water cress.

Water cress is a perennial floating pungent herb with pinnatified leaves and small white flowers. The leaves are used for salads.

Water cress is native of Europe, and was introduced into Baguio, Mountain Province, during the early years of the American occupation. It has become naturalized, and is common in the market. Analysis of an air-dried sample was made owing to the difficulty in getting green material from Baguio to Manila in good condition.

PASPALUM DILATATUM Poiret. Dallis grass.

Dallis grass is a coarse perennial, 40 to 60 centimeters tall, and a native of South America. Many years ago it was introduced into Trinidad valley, Benguet, where it has proved a good pasture grass. Though it will grow on the lowlands it is best adapted to elevations above 600 meters. The samples of this and the following grass were grown at the acclimatization station in Baguio.

PENNISETUM CLANDESTINUM. Kikuyu grass.

The kikuyu is a creeping grass similar to Bermuda grass except that it is much coarser and more robust. It was introduced into the Philippines about 1920, and promises to become an important pasture grass in the Mountain Province. It is a native of Africa.

PHYTOLACCA DIOICA Linnæus. Umbo.

The umbo is a large tree with a stout trunk. It grows very rapidly, and has glabrous elliptic or ovate leaves. The small flowers are borne in racemes. The fruits are small black berries.

The umbo is native of South America and has been introduced into various tropical countries as an ornamental shade tree, and also has been found useful for forage. It was introduced in 1928 in San Fernando, La Union, whence the sample was procured.

VIGNA MARINA (Burman) Merrill. Silani. Plate 21.

The silani, a pantropical strand plant, is a perennial, twining, climbing herb rooting along the vines. The leaves are trifoliate, and about the size of those of the cowpea to which the species is related. The flowers are yellow. The seeds are sparingly produced.

It has been demonstrated that this plant makes a good cover crop for cocos, aside from which it has possibilities as feed for domestic animals. The sample grew at the Singalong experiment station, Manila.

ALBIZZIA LEBBEKOIDES Bentham. Kariskis.

The kariskis is a small native tree about 12 meters high, with feathery, bipinnate leaves, and small narrow leaflets. The tree is very drought resistant, and cattle relish the tops. A sample for analysis to acertain the food value was procured in Ilocos.

SAMANEA SAMAN (Jacquin) Merrill. Rain-tree. Plate 22, fig. 1.

The rain-tree, commonly known in the Philippines as acacia, is a large, flat-topped, rapidly growing tree with a spread of 30 meters. The dark green leaves are bipinnate, with fairly large leaflets. The flowers are pinkish. The pods are flattened, sweet, dark brown, and 15 to 20 centimeters long.

The rain-tree is a native of tropical America and was long ago introduced by the Spaniards into the Philippines where it is a commonly planted shade tree. The pods ripen during the dry period and are fed to cattle and hogs. Since it has been found that cattle eat the tops, it is possible that the tree may have a double value for forage in regions with a long dry season where it thrives to perfection.

PROSOPIS JULIFLORA de Candolle. Algaroba. Plate 22, fig. 2.

The algaroba is a spiny tree 9 meters or more high with long slender branches and twice pinnate feathery leaves. The small greenish-yellow flowers are borne in cylindrical spikes. The pods are linear, flattened, leathery, straw-yellow, aromatic, rich in sugar, and contain many small seeds.

The algaroba is of West Indian origin, but was introduced long ago into Hawaii where it is highly valued for its pods which are eaten by cattle, and its flowers which yield a superior honey. Several introductions have been made into the Philippines, where the algaroba has found a congenial home, and on the dry waste lands promises to become a valuable plant. The sample was procured from a spineless tree found in Laoag, Ilocos Norte.

MEDICAGO SATIVA Linnæus. Alfalfa.

Alfalfa has been repeatedly introduced in Baguio, Mountain Province, where it makes a good growth during the dry period, but is unable successfully to endure the heavy precipitation during the rainy period. It seems unlikely that it will ever become of value as a forage in the Philippines. The sample of the alfalfa and the clovers were grown at the acclimatization station in Baguio.

TRIFOLIUM PRATENSE Linnæus. Red clover.

Red clover, like alfalfa, has been repeatedly imported into Baguio, Mountain Province, and makes a good growth during the dry season, but fails to maintain itself during the rainy period.

TRIFOLIUM REPENS Linnæus. White clover.

This pasture plant likewise has been introduced in the Mountain Province and grows well during dry weather but has failed to naturalize itself, and seems unlikely to become of value for forage in the Philippines.

EXPERIMENTAL PROCEDURE AND RESULTS

The ripe, mature fruits were first weighed. The edible and waste portions were carefully separated and weighed. The edible portion was passed through a meat grinder until uniform representative samples were obtained.

The different constituents were determined according to the methods given by the Association of Official Agricultural Chemists.

Carbohydrates, other than starch and crude fiber, were obtained by subtracting the percentages of all other constituents from 100.

The calorific values, or heat of combustion, of 100 grams of food material, were calculated from the result of the analysis in accordance with the standard fuel values of Rubner.[6]

	Calories (per gram).
Carbohydrates	4.1
Fats	9.3
Protein	4.1

In Table 1 is given the composition of various Philippine bananas. The Pinipita has the highest percentage of total solids (36.34), the highest percentage of reducing sugar (31.25) and the highest number of calories per 100 grams (149.5). The Payyang has the largest average weight of fruit (343.0 grams).

In Table 2 is given the composition of various Philippine fruits which are not common, and a few that are cultivated only to a limited extent. The hevi has the largest number of calories per 100 grams (157.3). The vilatti has the highest percentage of protein (2.93), the highest percentage of fat (3.04), and

[6] Sherman, Chemistry of Foods and Nutrition (1918) 143.

also the highest percentage of crude fiber (10.5). The high percentage of reducing sugar in the Rizal mabolo (18.52), in the papache (21.66), and in the serali (21.74) is worthy of notice; likewise the low percentage of fat (5.46) in the Alegre avocado. The zapote is the largest of these fruits, one fruit may weigh as much as 730 grams.

The composition of some Philippine tubers and seeds is given in Table 3. The kanari has a high percentage of total solids (96.24), protein (19.57), fat (72.84), ash (3.58), and the highest number of calories per 100 grams (757.94). Of the tubers, the pulau gave the highest number of calories per 100 grams (183.3) and the highest percentage of solids (46.05), protein (5.87), fat (1.06), starch (27.37), and ash (1.13). A good quality of starch (Plate 16, fig. 2) has been prepared from this tuber.

In Table 4 is given the composition of some Philippine vegetables., The cassava leaves gave the highest percentage of total solids (17.52) and the highest number of calories per 100 grams (64.98). The maluko gave the highest percentage of protein (6.05).

The composition of the forages is presented in Table 5. The high protein content of the dry materials is worthy of note. In alfalfa and red clover the percentage of protein is 24.23 and 20.69, whereas average analyses for these forages in the United States are 14.30 and 12.30 per cent, respectively.[7] The air-dried leaves of the umbo have 21.96 per cent of protein. The average fat content of red clover in the United States is 3.3 per cent as agaist 5.55 per cent in Philippine-grown material. The carbohydrate content of alfalfa, red clover, and white clover is approximately the same as in the United States. Rain-tree pods have a high sugar content (23.60 sucrose and 13.69 reducing sugar).

SUMMARY

In this investigation the composition was determined of six varieties of Philippine bananas, one from Guam, eighteen Philippine fruits, three tubers, and three kinds of seeds, six vegetables, and twelve forages, a total of forty-nine.

[7] Jordan, W. H., The Feeding of Animals (1901) 423.

TABLE 1.—*Composition of Philippine bananas.*

Name.	Average weight of one fruit.	Edible portion.	Total solids.	Moisture.	Protein N x 6.25.	Ether extract (fat).	Sucrose.	Reducing sugar.	Crude fiber.	Other carbohydrates (by difference).	Ash.	Acidity as acetic.	Calories per 100 grams.
	g.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	
Pink bananas from Guam			26.20	73.80	1.72	0.14	6.55	13.78		3.09	0.92		104.38
Sinangil	52.0	79.71	27.58	72.42	1.40	1.04	10.4	14.00			0.74		115.45
Pinfpita	70.0	47.62	36.34	63.66	1.11	0.85		31.25		2.19	0.94		149.56
Inaldaba	70.5	56.74	35.70	64.3	1.44	0.57	3.45	15.15	0.48	13.56	1.05		143.06
Payyang	343.0	83.38	31.3	68.70	1.53	0.64		18.51		9.90	0.72	0.38	128.7
Sinamba	107.0	69.15	32.9	67.10	1.78	0.58		20.24		9.52	0.78		141.0
San Juan			35.52	64.48	0.93	2.31		19.23	0.52		0.52		104.13

TABLE 2.—*Composition of Philippine fruits.*

Name.	Average weight of one fruit.	Edible portion.	Total solids.	Moisture.	Protein N x 6.25.	Ether extract (fat).	Sucrose.	Reducing sugar.	Crude fiber.	Other carbohydrates (by difference).	Ash.	Acidity as acetic.	Calories per 100 grams.
	g.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	
Kalapi, sweet variety, *Calamus ornatus* Blume var. *philippinensis* Becc.	8.0	41.87	21.54	78.46	1.16	0.41		10.94	0.42	7.28	1.33	1.80	87.15
Kalapi, sour variety, *Calamus ornatus* Blume var. *philippinensis* Becc.	7.7	45.83	17.25	82.75	0.86	0.36		8.84	0.45	5.91	0.83	2.52	70.47
Guamá, *Inga laurina* Willd		26.57	15.18	84.82	0.72	0.36		9.27		4.30	0.53		64.79
Vilatti, *Feronia limonia* Swingle	277.0	63.9	29.19	70.81	2.93	3.04			10.50	11.14	1.58		85.90
Hevi, *Spondias cytherea* Sonn			40.35	59.65	0.80	1.79	8.05	6.41	3.60	19.05	0.65		157.30
Bika, *Ampelocissus martini* Planch.	2.4	76.05	10.95	89.05	1.61	1.17		7.65	0.21		0.31	1.66	48.85

Kambog, *Dillenia mindanaensis* Elm.	83.0	37.60	6.61	93.39	0.53	0.11			0.32	5.31	0.34	1.24	26.14
Rukam, *Flacourtia rukam* Zoll. and Morr.			23.07	76.93	1.72	1.26		4.32	3.71	11.29	0.77	1.29	82.80
Valesca mabolo, *Diospyros discolor* Wild.	358.0	78.40	16.98	83.02	2.79	0.22		6.25	1.76	5.53	0.43		61.78
Seedless mabolo, Rizal	172.0	84.43	28.05	71.95	0.86	0.25		18.52	1.73	5.49	1.20		104.29
Zapote, *Diospyros ebenaster* Retz.	730.0	88.25	18.46	81.54	1.15	0.26	6.50	6.94	0.43	2.69	0.49		73.26
Cyndra, *Cyphomandra betacea* Sdt.			15.59	84.41	1.09	0.34		5.31	1.97	5.95	0.93	1.51	53.80
Muti, *Solanum nigrum* L.			13.98	86.02	2.51	0.56			4.15	5.57	1.19		38.30
Papache, *Randia echinocarpa* M. and S.	57.0	31.5	28.80	71.20	1.53	0.55		21.66	0.95	3.31	0.80		113.77
Alegre avocado, *Persea americana* Mill.	1,048.0	75.8	14.58	85.48	1.23	5.46		1.38	1.32	4.56	0.63		80.17
Serali, *Flacourtia ramontchi*, l'Herit.			33.75	66.25	1.34	0.27		21.74	1.40	7.95	1.05		129.7
Iba, *Cicca acida* (L.) Merr.			10.37	89.63	0.90	0.76			0.58	7.29	0.84	1.70	40.6
Dalaya juice, *Citrus aurantifolia* Swg. var. *aromatica* Wester			7.64					0.23				[a] 6.44	

[a] As citric.

TABLE 3.—*Composition of Philippine tubers and seeds.*

Name.	Average weight of one seed.	Edible portion.	Total solids.	Moisture.	Protein N x 6.25.	Ether extract (fat).	Crude fiber.	Starch.	Other carbohydrates (by difference).	Ash.	Calories per 100 grams.
	g.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	
Palauan, *Cyrtosperma merkusii* (Hassk.) Schott			37.39	62.61	0.81	0.09	1.57	22.92	10.95	1.05	148.02
Biga, *Alocasia macrorrhiza* (Linn.) Schott			36.82	63.18	3.27	0.24	1.14	20.45	10.62	1.10	143.03
Pulau, *Nymphaea nouchali* Burm. f.			46.05	53.95	5.87	1.06	1.55	27.37	9.07	1.13	183.30
Kanari, *Canarium commune* Linn.	8.5		96.24	3.76	19.57	72.84	0.18		0.07	3.58	757.94
Marang, *Artocarpus odoratissima* Blanco	1.63	92.59	35.45	64.55	1.29	13.29	0.52		18.71	1.64	205.60
Tambulian, *Eusiderozylon zwageri* Teysm. and Binn.		57.37	67.46	32.54	4.73	1.74	2.30	49.95	6.94	1.80	268.82

TABLE 4.—*Composition of Philippine vegetables.*

Name.	Total solids.	Moisture.	Protein N x 6.25.	Ether extract (fat).	Crude fiber.	Other carbohydrates (by difference).	Ash.	Calories per 100 grams.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	
Talinum, *Talinum triangulare* Willd	7.51	92.49	2.19	1.30	0.72	1.70	1.60	28.0
Cassava leaves, *Manihot utilissima* Pohl	17.52	82.48	2.32	1.52	2.44	10.08	1.16	64.98
Maluko leaves, *Pisonia alba* Spanoghe	16.07	83.93	6.05	0.61	2.67	4.37	2.37	48.40
Kakauâti flowers, *Gliricida sepium* (Jacq.) Steud	14.54	85.46	3.67	1.47	2.42	5.94	1.04	55.0
Chayote, *Sechium edule* Sw	6.72	93.28	0.64	0.24	0.36	5.25	0.23	26.38
Water cress (air dried), *Nasturtium officinale* R. Brown	87.72	12.28	27.65	3.11	10.16	31.80	15.00	

TABLE 5—*Composition of Philippine forages.*

Name.	Moisture.	Protein N x 6.25.	Ether extract (fat).	Crude fiber.	Insoluble carbohydrates (by difference).	Ash.	Sucrose.	Reducing sugar.	Calories per 100 grams.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	
Dallis grass (hay), *Paspalum dilatatum* Poiret	11.17	19.51	3.53	17.45	40.93	7.41	------	------	280.63
Kikuyu grass (green), *Pennisetum clandestinum*	80.64	4.08	0.67	5.26	7.93	1.42	------	------	55.47
Kikuyu grass (hay), *Pennisetum clandestinum*	16.33	16.36	2.98	18.76	34.81	10.76	------	------	237.50
Umbo (air-dried leaves), *Phytolacca dioica* Linn	3.04	21.96	2.93	9.05	61.74	1.28	------	------	370.31
Silani (green), *Vigna marina* (Burm.), Merr	84.42	3.13	0.71	2.58	7.70	1.46	------	------	51.01
Kariskis (air-dried leaves), *Albizzia lebbekoides* Bth	9.03	19.51	2.67	18.15	46.43	4.21	------	------	295.18
Kakauati (green leaves), *Gliricidia sepium* Steud	73.32	5.56	1.93	8.70	7.97	2.52	------	------	73.41
Rain-tree (green leaves), *Samanea saman* (Jacq.) Merr	47.78	10.22	2.13	15.73	22.19	1.95	------	------	152.68
Rain-tree (ripe pods), *Samanea saman* (Jacq.) Merr	15.23	10.73	2.50	9.58	21.25	3.42	23.60	13.69	307.25
Algaroba, spineless (ripe pods), *Prosopis juliflora* DC	15.28	5.67	2.72	11.65	17.76	3.10	33.68	10.14	301.02
Alfalfa (hay), *Medicago sativa* Linn	10.93	24.23	3.33	19.49	33.48	8.54	------	------	267.57
Red-clover (hay), *Trifolium pratense* Linn	6.65	20.60	5.55	18.01	41.06	8.13	------	------	304.41
White-clover (hay), *Trifolium repens* Linn	13.04	18.94	3.35	15.88	39.23	9.56	------	------	269.64

ILLUSTRATIONS

PLATE 1

FIG. 1. Pink banana from Guam.
2. Sinangil banana.

PLATE 2

FIG. 1. Pinipita banana.
2. Inaldaba banana.

PLATE 3

FIG. 1. Payyang banana.
2. Sinamba banana.

PLATE 4

Calamus ornatus Blume var. *philippinensis* Beccari. Kalapi.

PLATE 5

FIG. 1. *Inga laurina* Willdenow. Guamá.
2. *Feronia limonia* Swingle. Vilatti.

PLATE 6

FIG. 1. *Spondias cytherea* Sonnerat. Hevi.
2. *Ampelocissus martini* Planchon. Bika.

PLATE 7

FIG. 1. *Dillenia mindanaensis* Elmer. Kambóg.
2. *Flacourtia rukam* Zollinger and Morren.

PLATE 8

FIG. 1. *Diospyros discolor* Willdenow. Valesca mabolo.
2. *Diospyros discolor* Willdenow. Rizal mabolo.

PLATE 9

FIG. 1. *Diospyros ebenaster* Retzius. Zapote.
2. *Cyphomandra betacea* Sendter. Cyndra.

PLATE 10

FIG. 1. *Solanum nigrum* Linnæus. Muti.
2. *Randia echinocarpa* Moc and Sessé. Papache.

PLATE 11

FIG. 1. *Persea americana* Miller. Avocado, Alegre variety.
2. *Flacourtia ramontchi* l'Herit. Serali.

PLATE 12

FIG. 1. *Citrus aurantifolia* Swingle var. *aromatica* Wester. Dalaya.
2. *Cicca acida* (Linnæus) Merrill. Iba.

PLATE 13

Cyrtosperma merkusii (Hasskarl) Schott. Palauan.

PLATE 14

Palauan plants on Leyte Island.

PLATE 15

Alocasia macrorrhiza (Linnæus) Schott. Biga.

PLATE 16

FIG. 1. *Nymphaea nouchali* Burman f. Pulau.
2. Starch from pulau tuber, × 300.

PLATE 17

FIG. 1. *Canarium commune* Linnæus. Kanari.
2. *Eusideroxylon zwageri* Teysmann and Binnendijk. Tambulian.

PLATE 18

A young maráng tree, Tetuan, Zamboanga.

PLATE 19

FIG. 1. *Artocarpus odoratissima* Blanco. Maráng.
2. *Talinum triangulare* Willdenow. Talinum.

PLATE 20

FIG. 1. *Gliricidia sepium* (Jacquin) Steudel. Kakauati flowers.
2. *Sechium edule* Swartze. Chayote.

PLATE 21

FIG. 1. *Vigna marina* (Burman) Merrill, silani, grown at the Lamao experiment station.
2. *Vigna marina* (Burman) Merrill. Silani.

PLATE 22

FIG. 1. *Samanea saman* (Jacquin) Merrill. Rain-tree.
2. *Prosopis juliflora* de Candolle. Algaroba.

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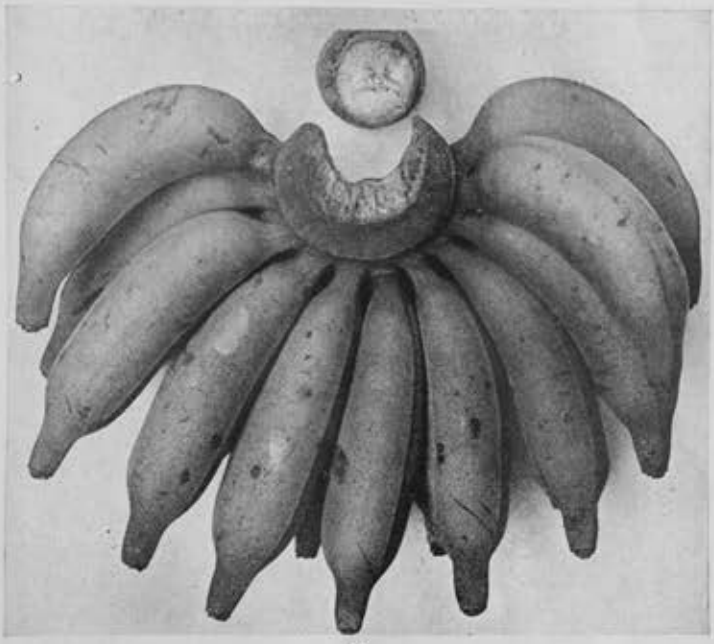

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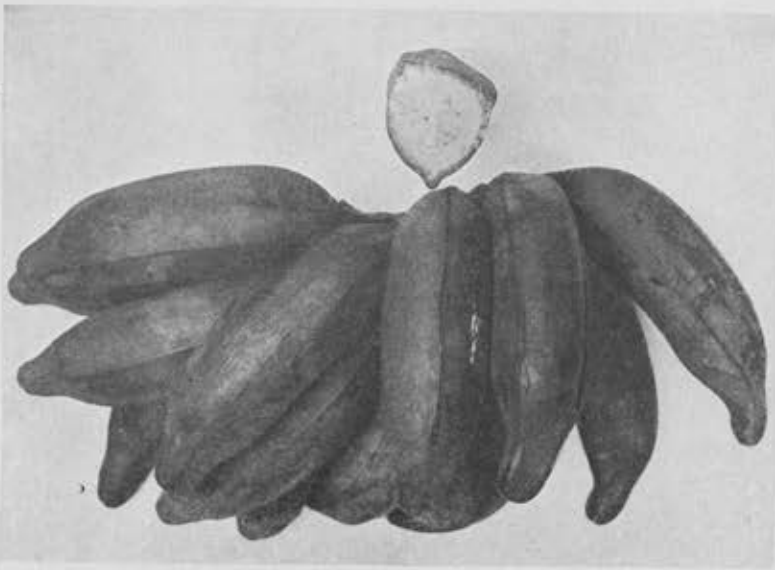

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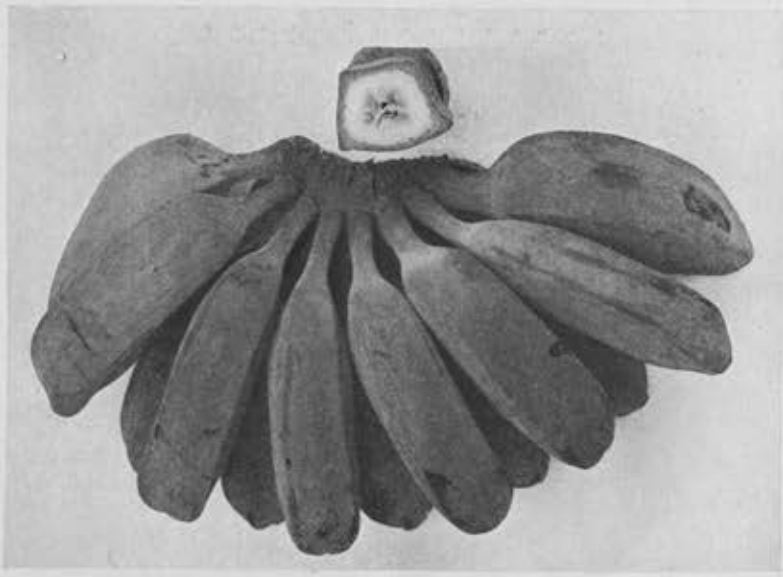

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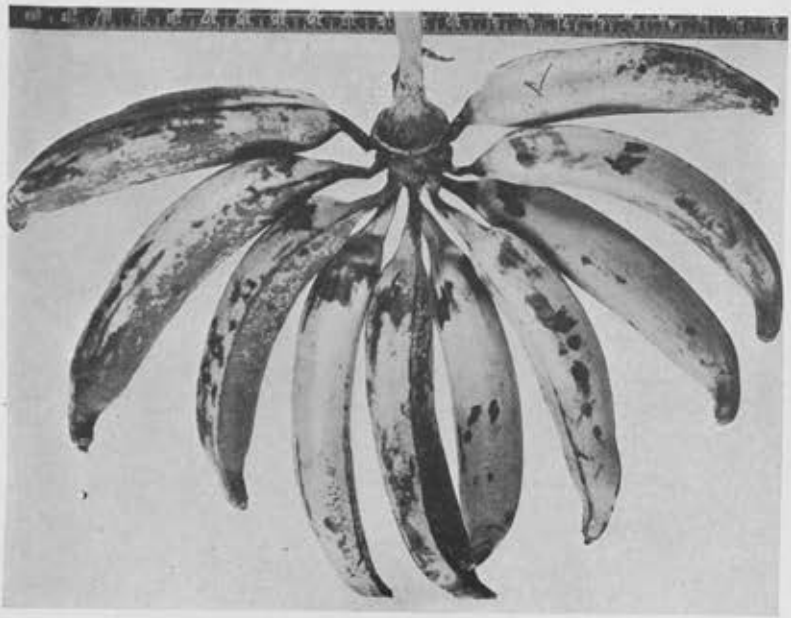

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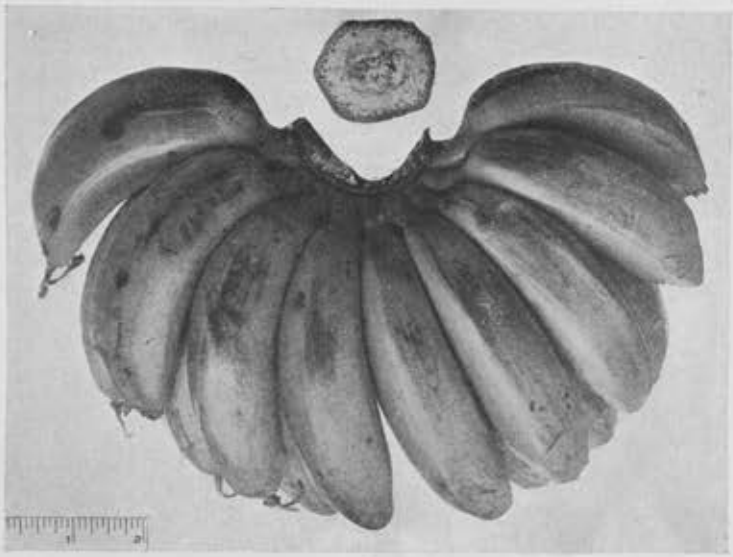

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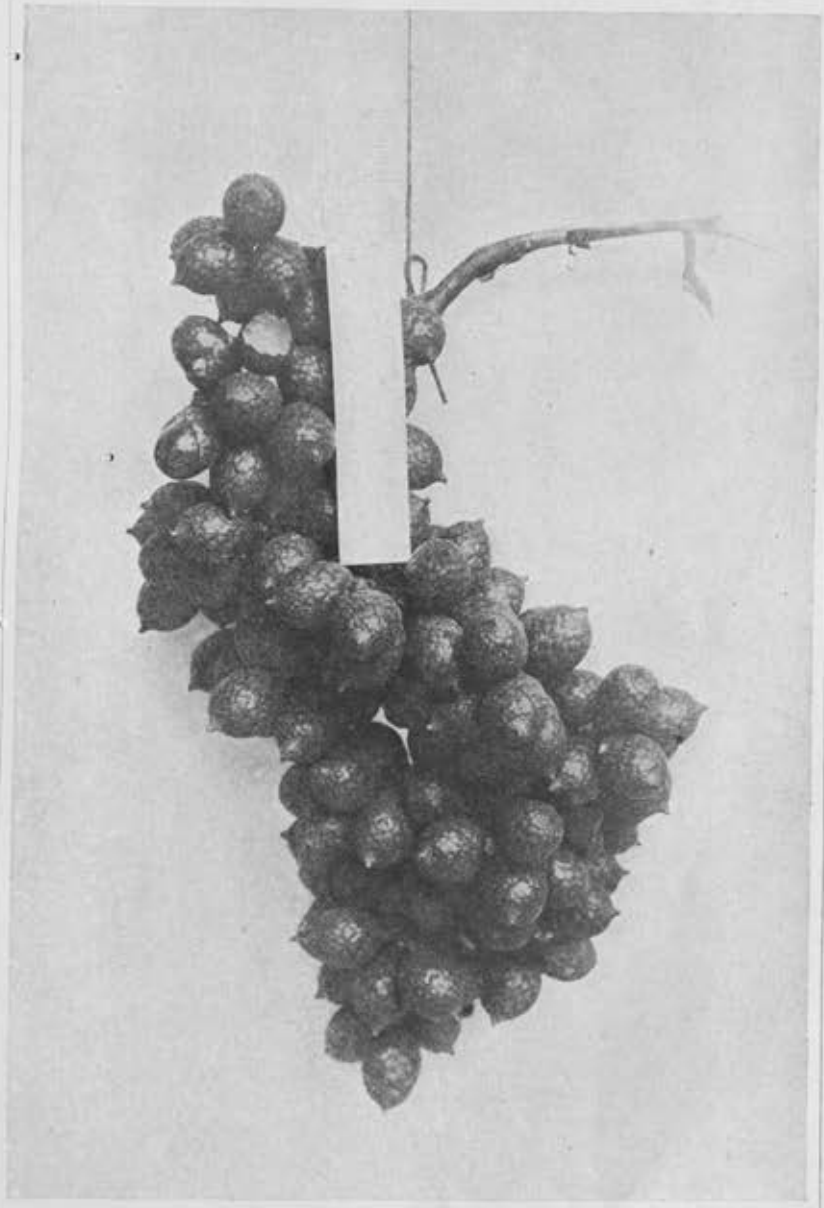

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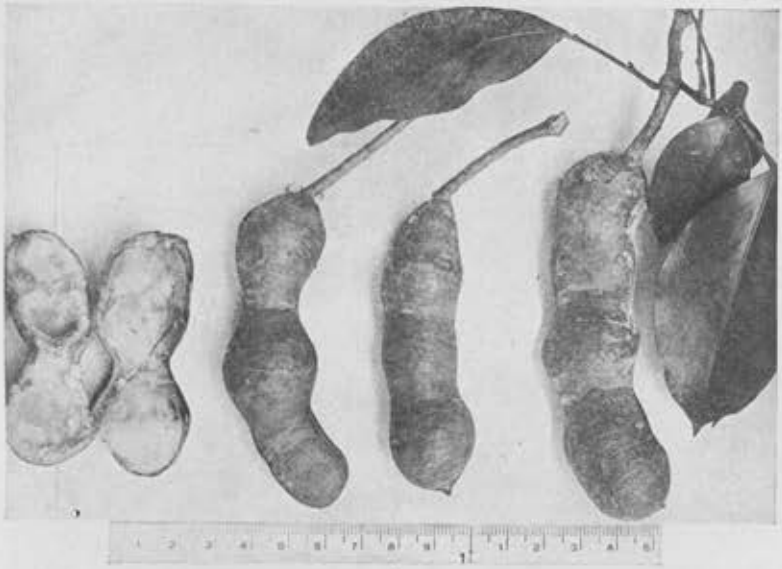

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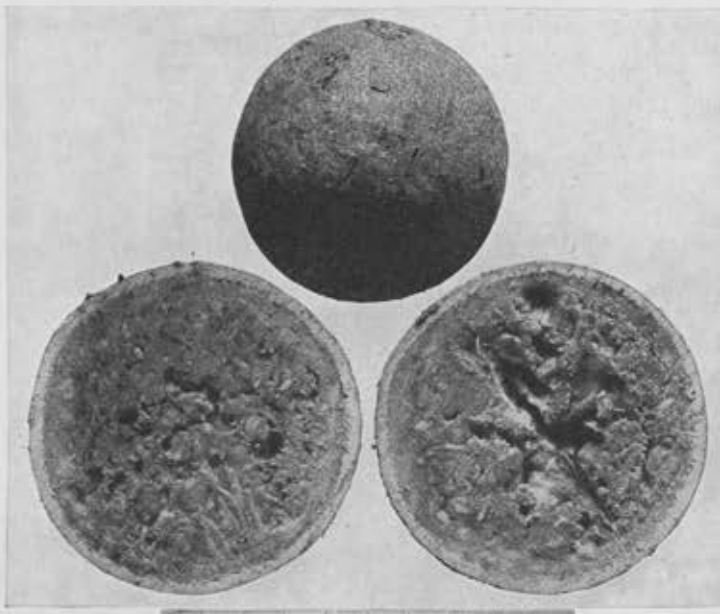

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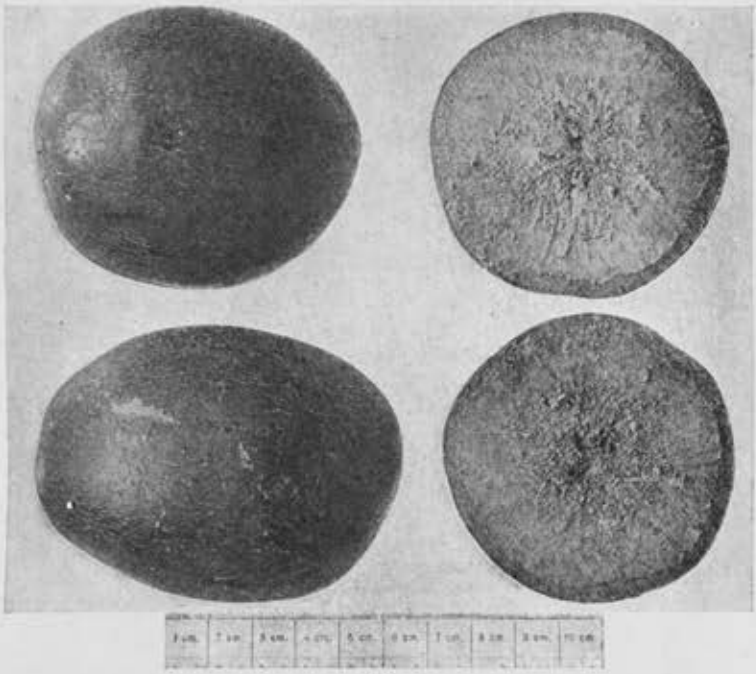

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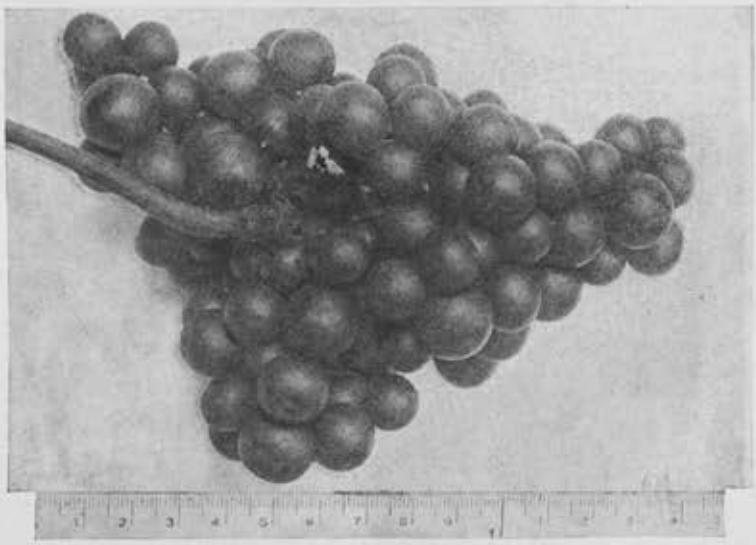

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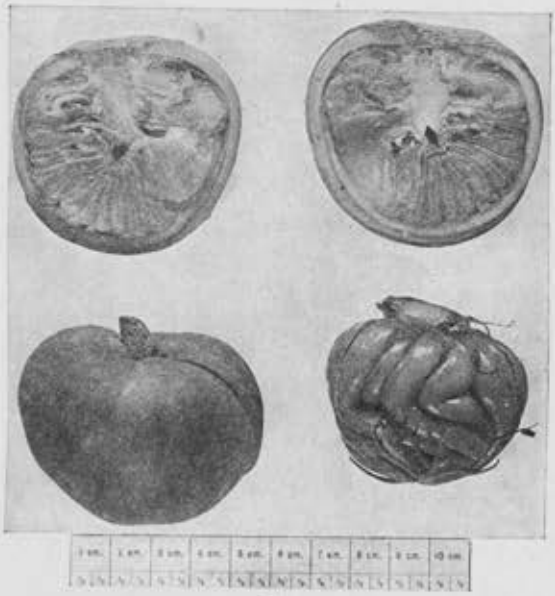

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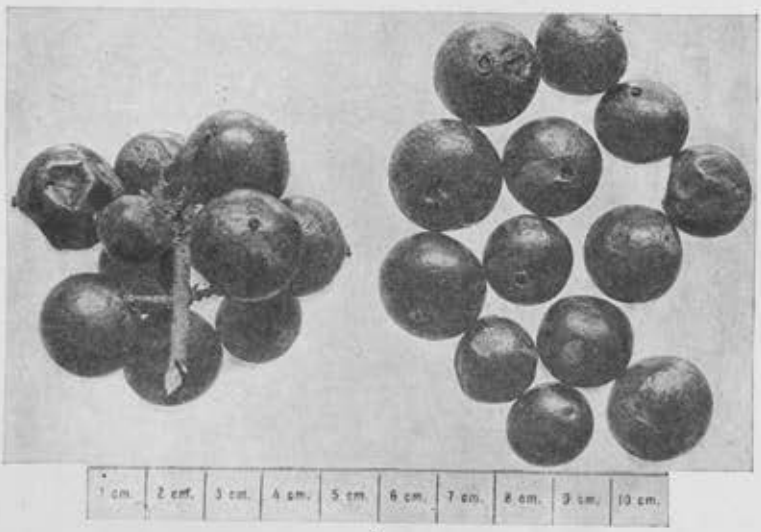

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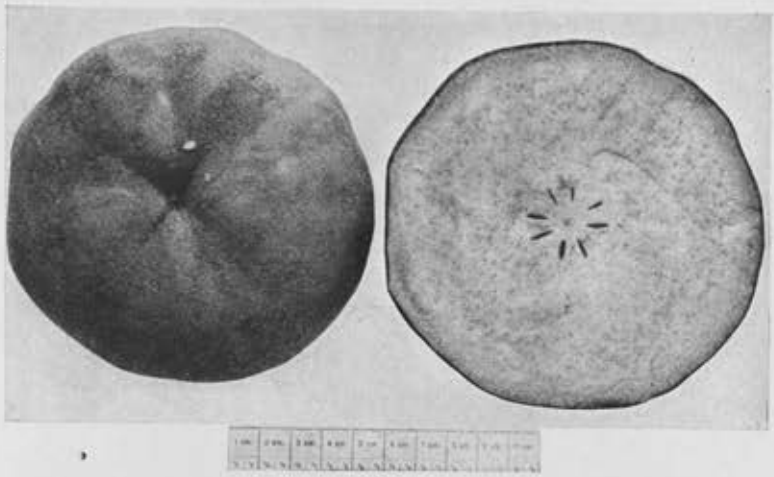

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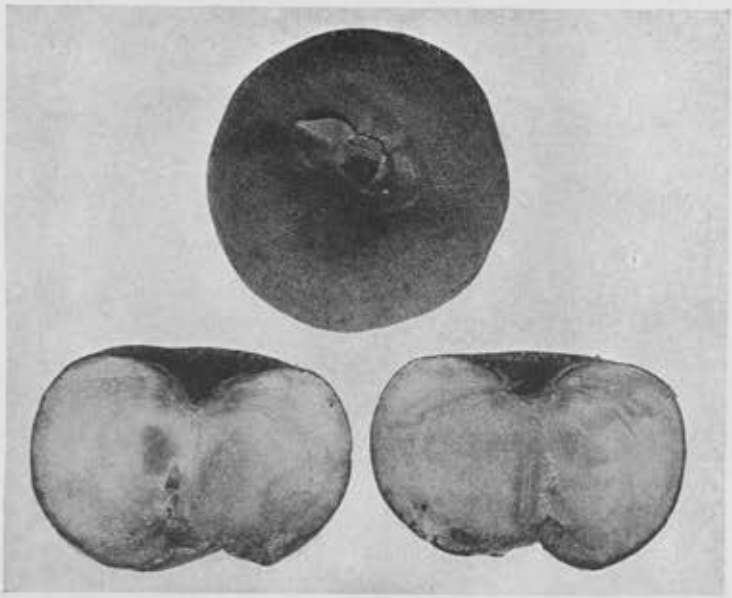

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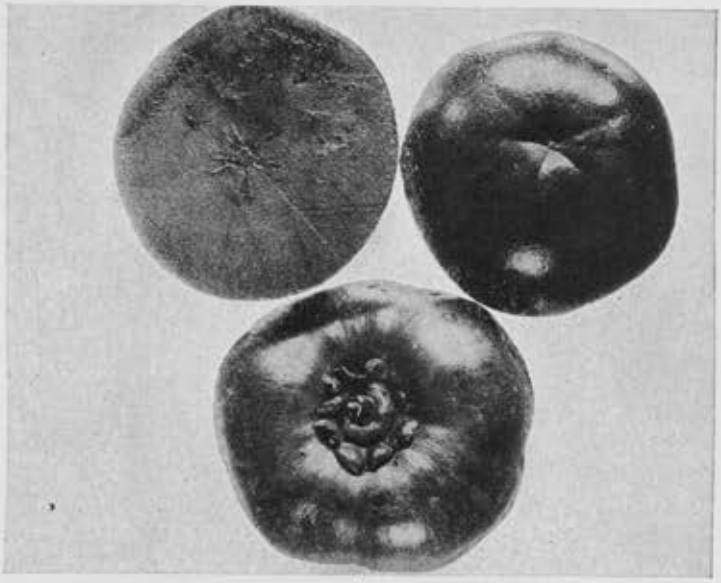

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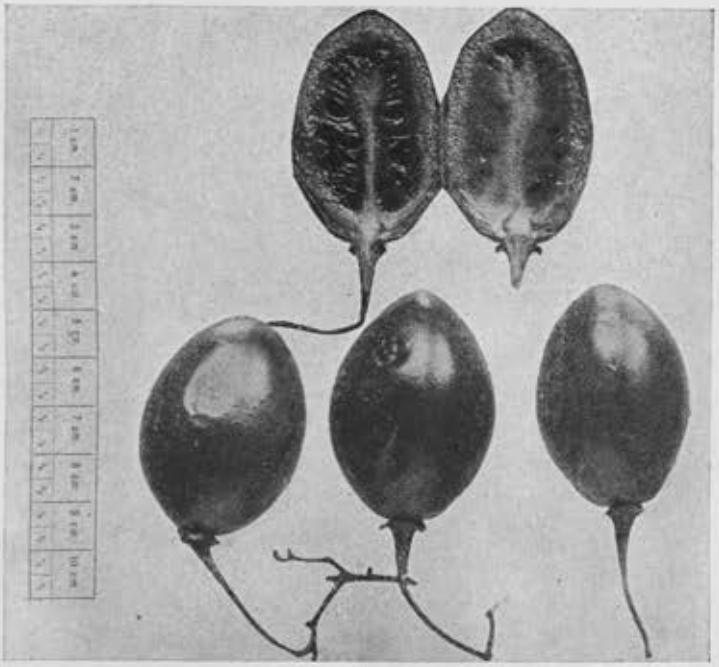

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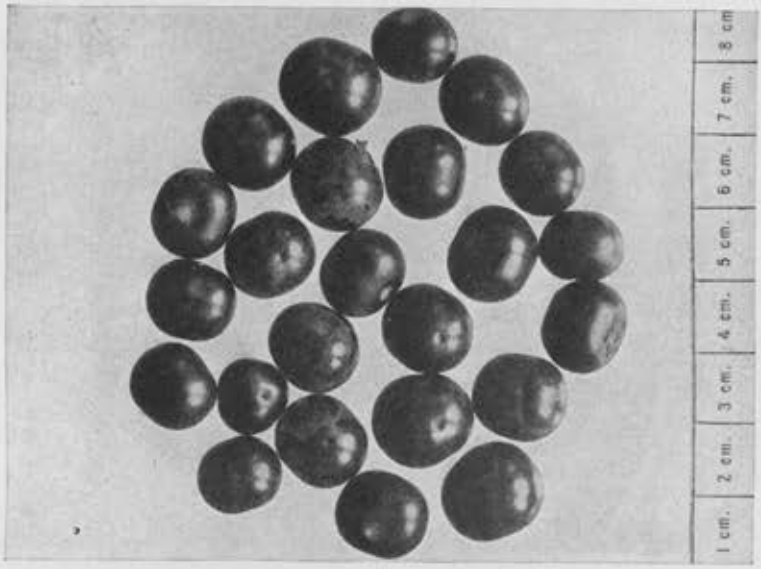

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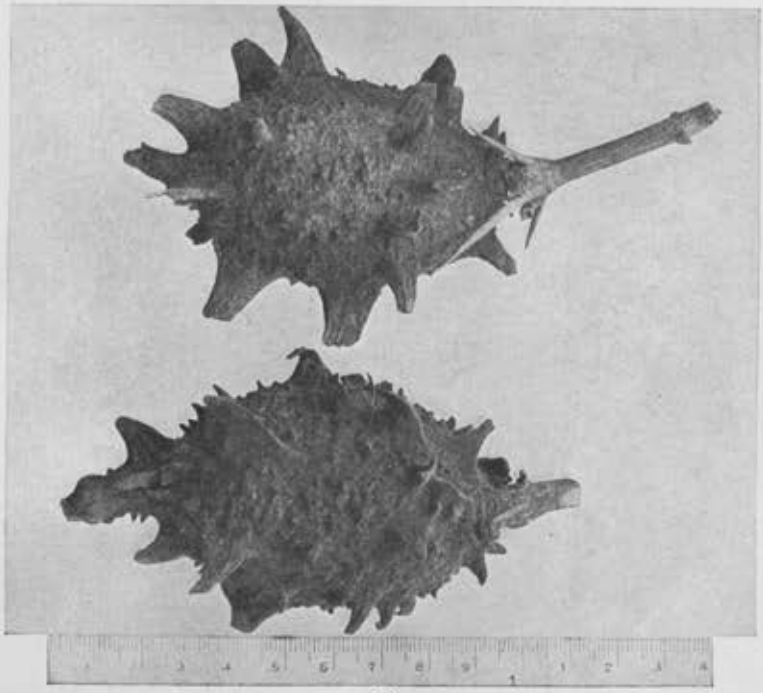

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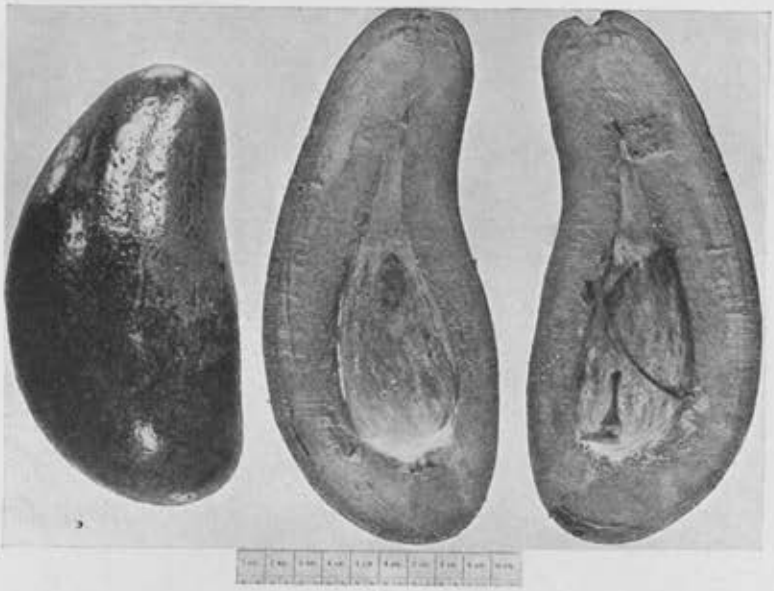
PLATE 10.



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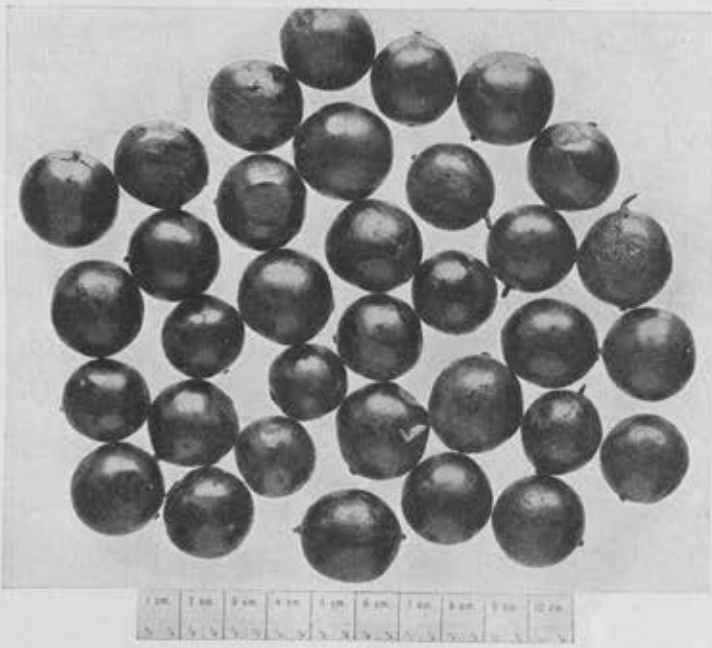

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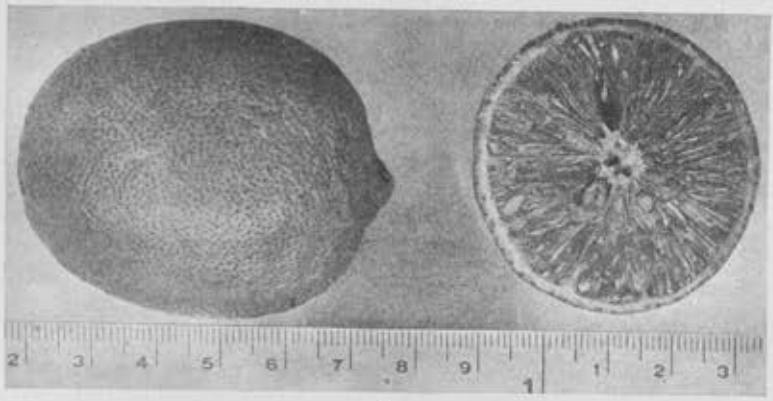

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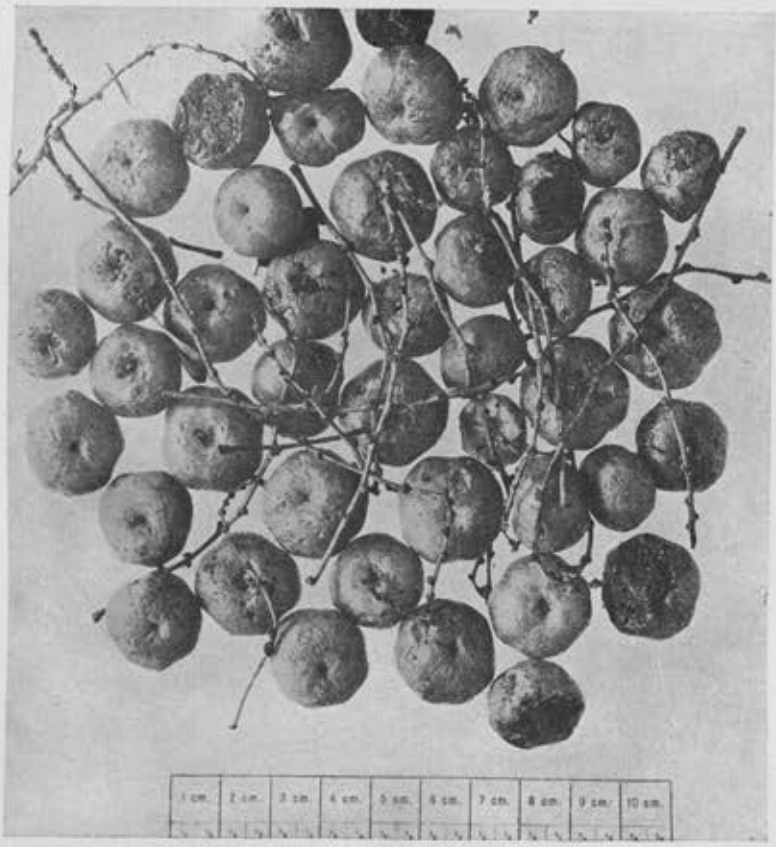

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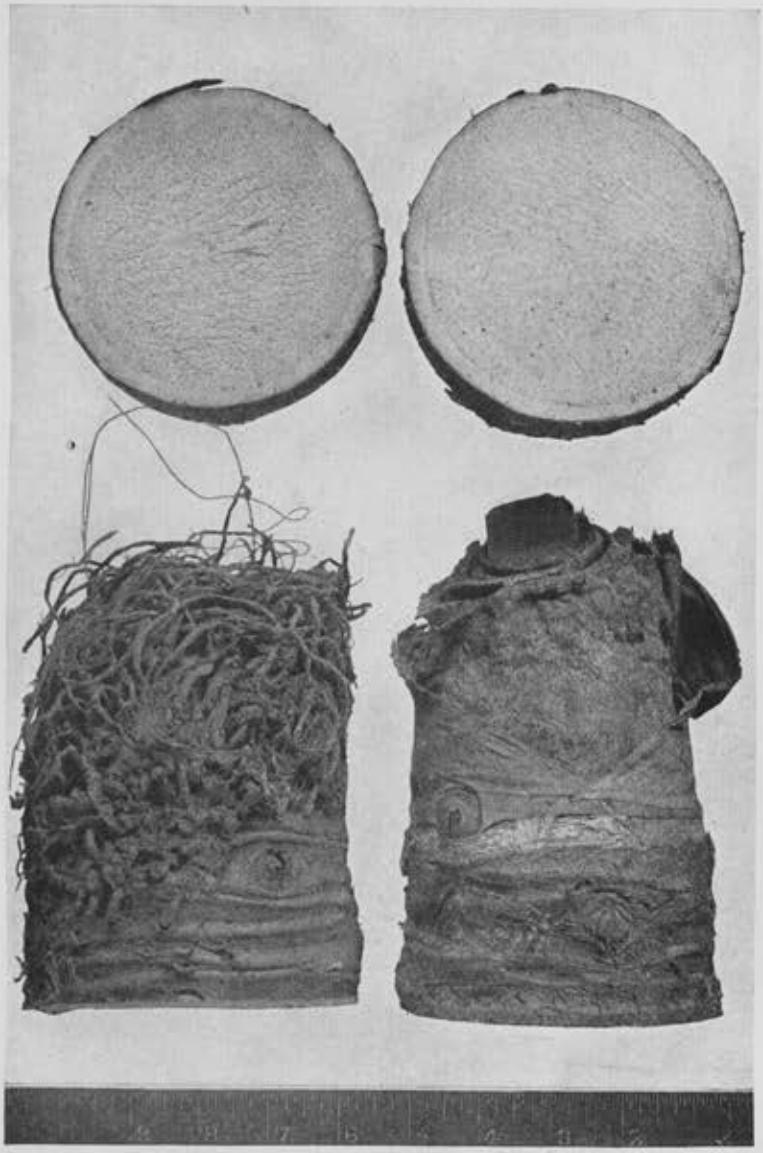
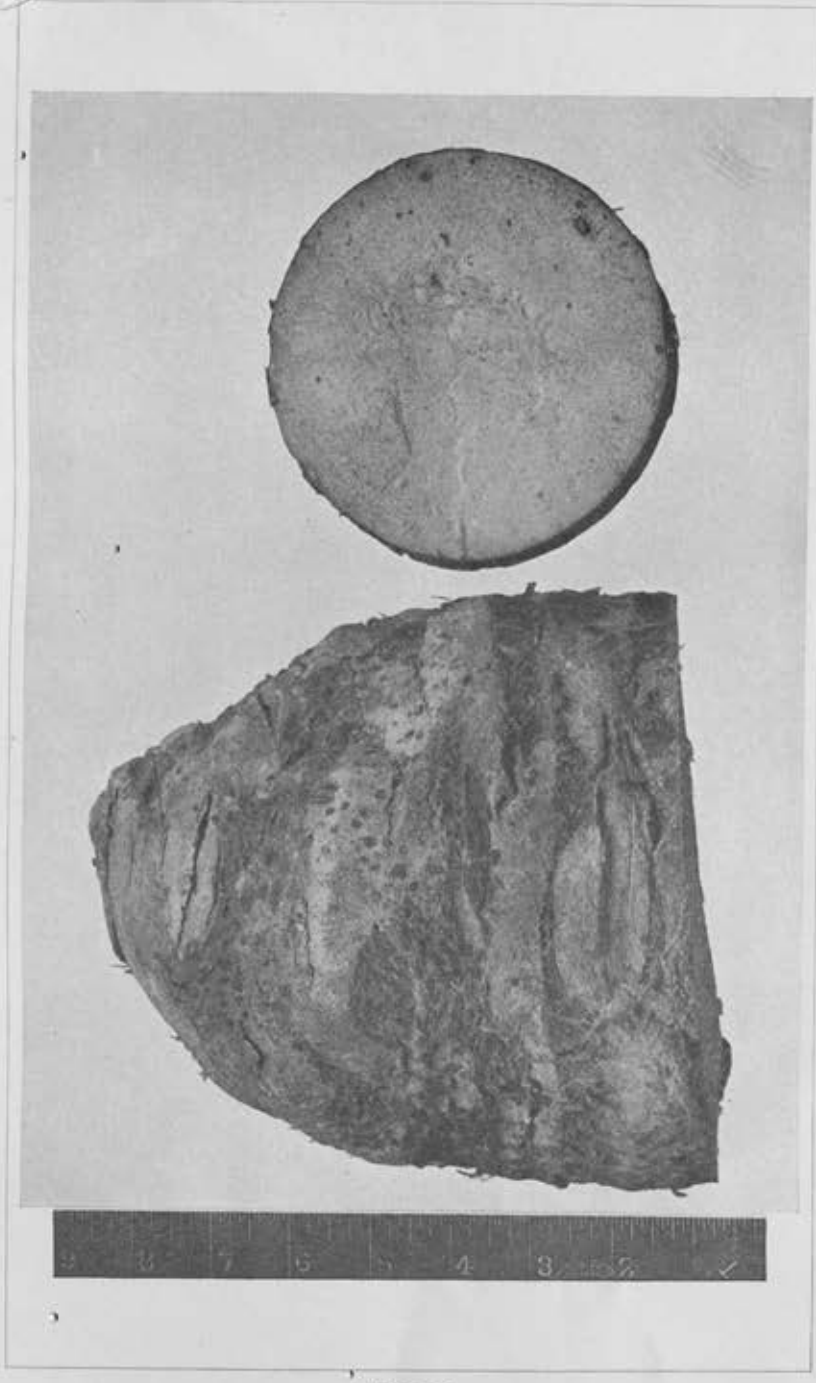


PLATE 13.

PLATE 14.



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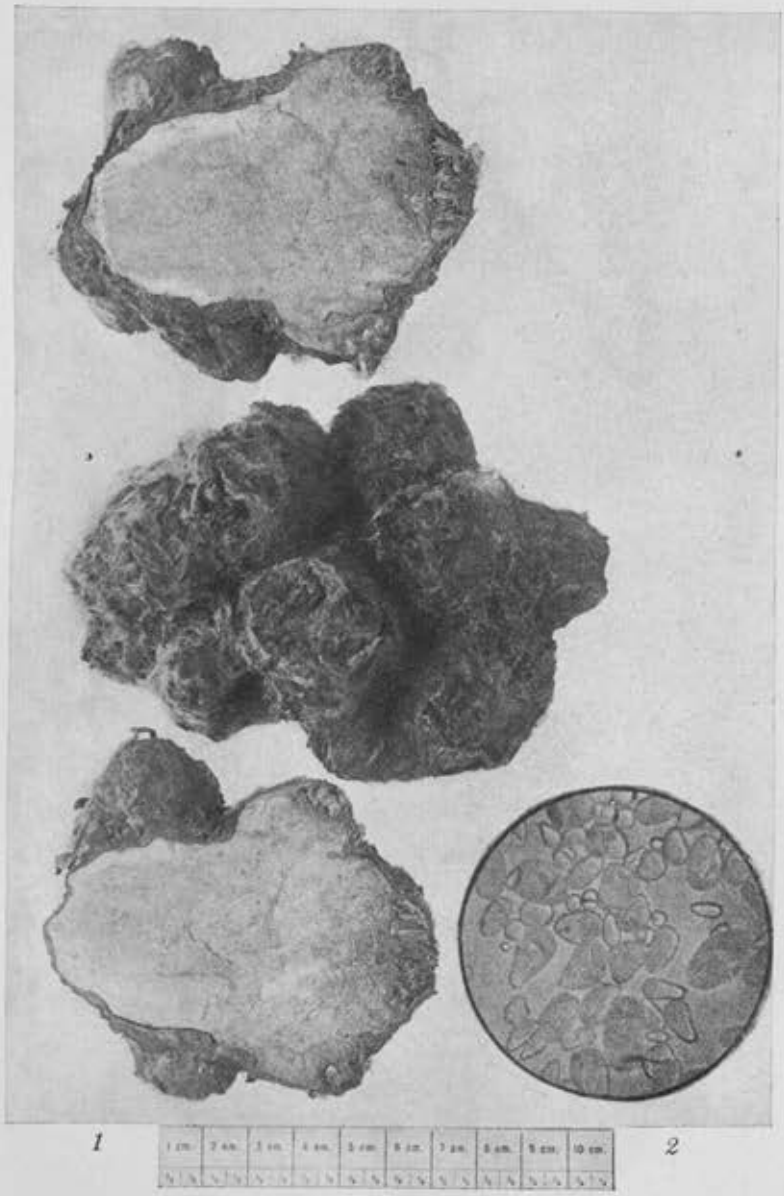

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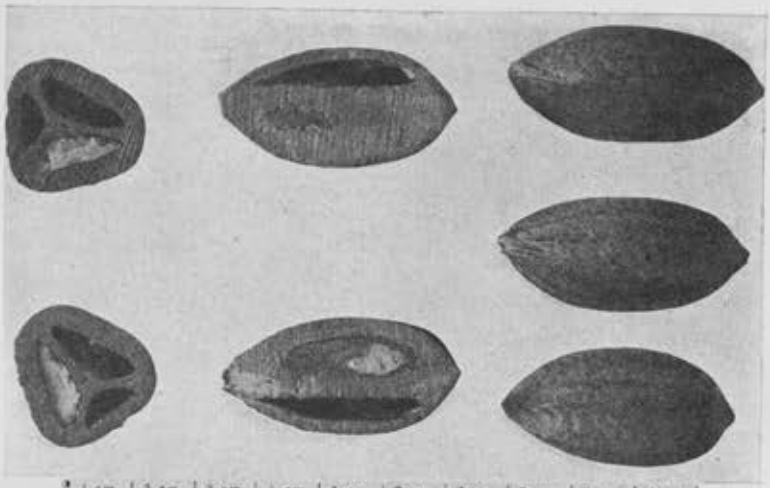

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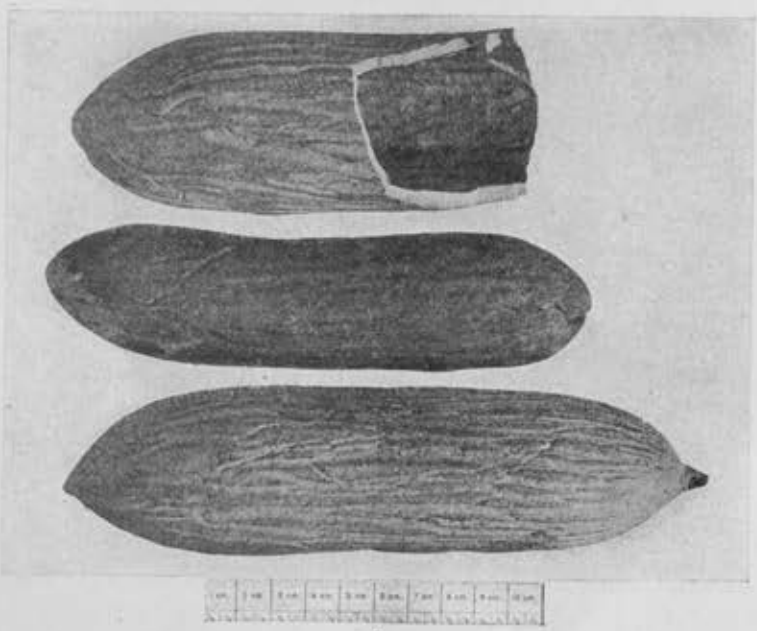

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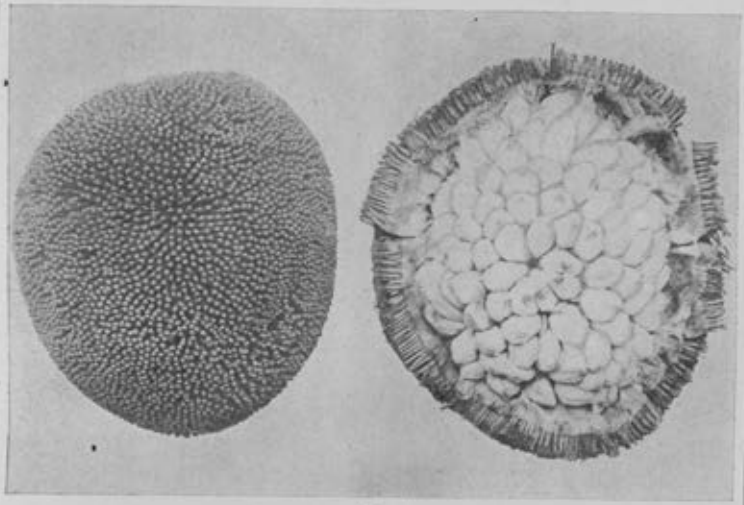
PLATE 17.

PLATE 18.



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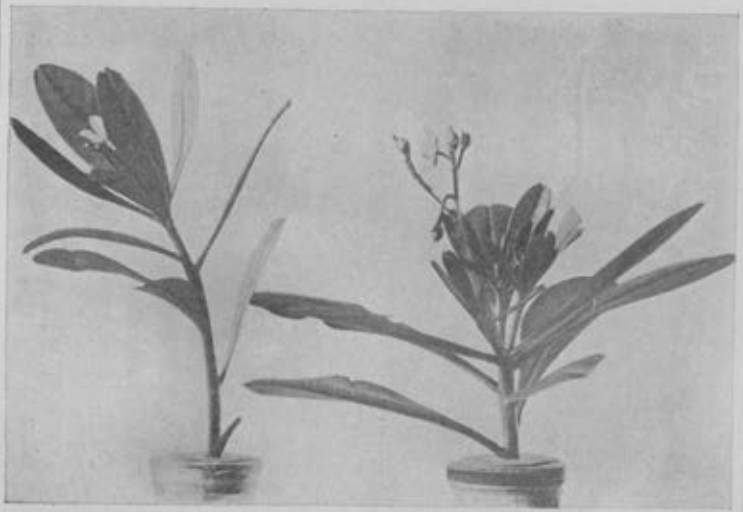

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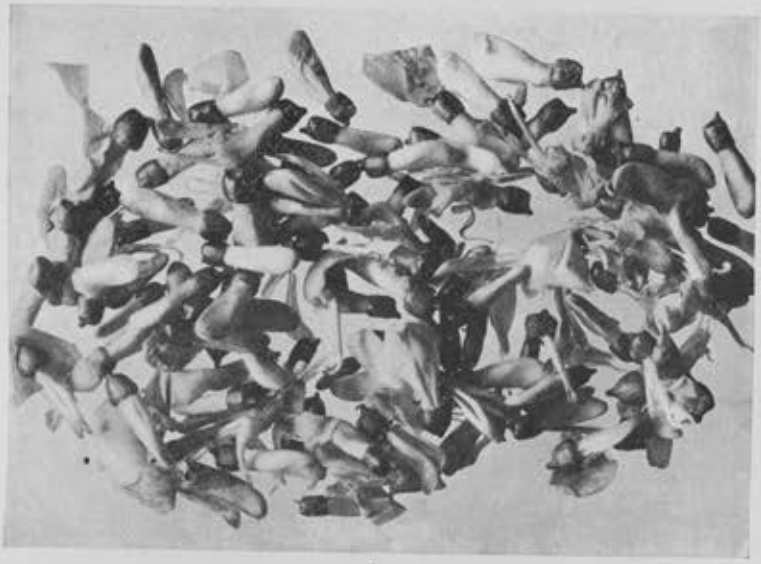

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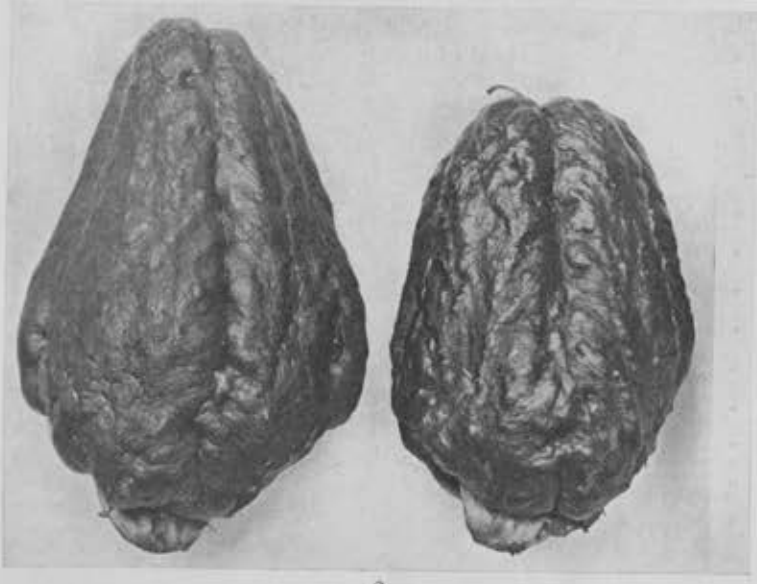

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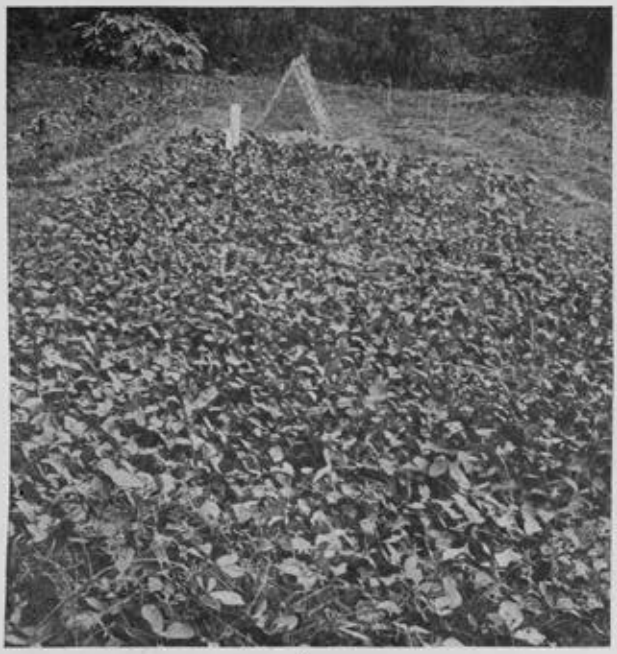

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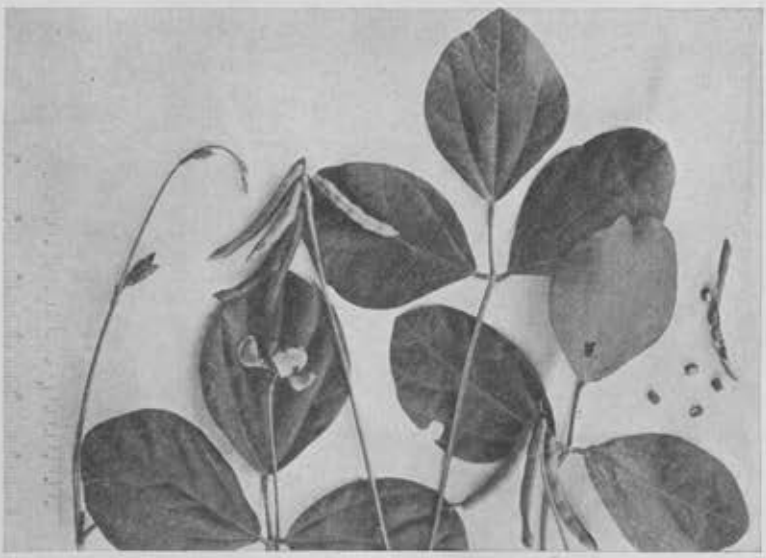

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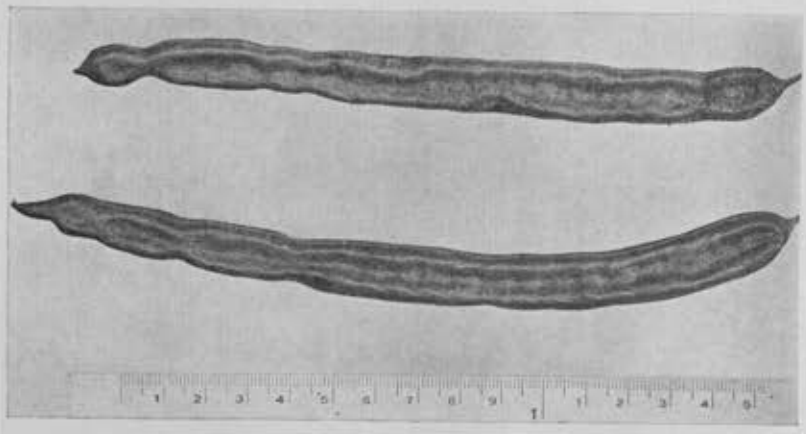

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PLATE 22.